POWER

Volume 59 New York, January 15, 1924 *No.* 3

If Everybody Did It

ON my way to the office I pass through a long underground passage from the train to the subway. In the morning most of the crowd is going the same way and progress is slow. To accommodate the few walking in the opposite direction a narrow strip is roped off at the left of the passage.

So long as everybody Keeps to the Right, as requested, all goes well, but occasionally an important looking individual, who evidently thinks that such requests and regulations are made for the hoi polloi, struts grandly down the narrow alley as though it were kept open for his especial benefit.

Not long does he enjoy this prerogative alone. "If he can do it, I can," thinks many another, and soon the little passageway is full of usurpers of special privilege, forging, at the expense of orderly progress and general advantage, ahead of those who have more respect for the common good.

This is to me typical of many things in life. We all do things that we know are not right, accept or assume privileges to which we are not in fairness entitled, justifying ourselves and calming our consciences by the thought that others do it and that we should be left behind in the running if we failed to avail ourselves of such opportunities when they come our way.

How much better a place this old world would be to live in if we governed our conduct in such respects by some consideration of what the effect would be if everybody did it.

F. R. Low

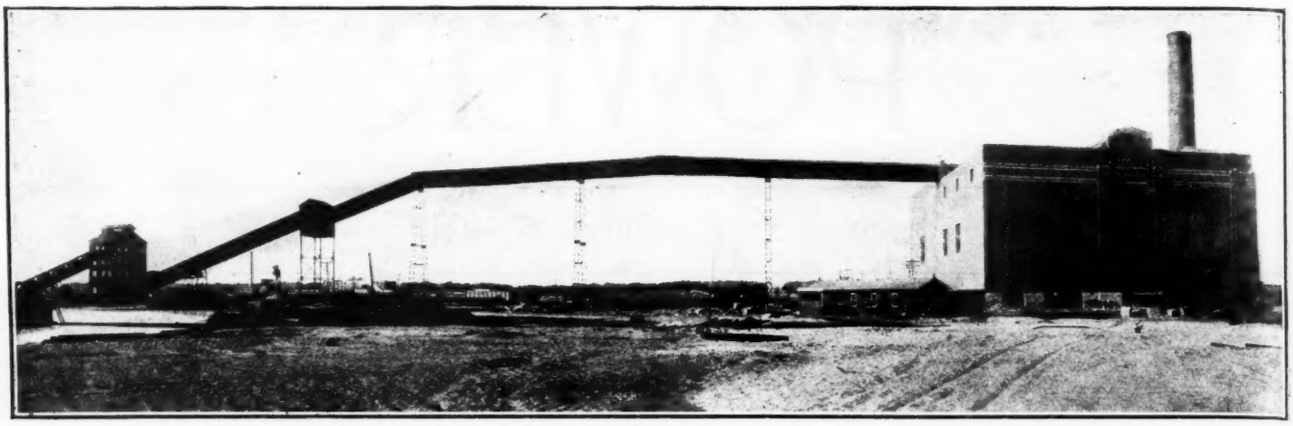


Fig. 1—Waukegan power station with coal-handling system for ultimate plant

New Waukegan Power Station

First Unit of 250,000-Kw. Base-Load Plant—Boilers Designed for 400 Lb. and 700 Deg.—Alternating-Current Stoker Drive Arranged for Forty Speeds—No Direct-Current Motors Used—Coal-Handling and Feed-Water System of Special Interest

AT WAUKEGAN, the first unit of a plant designed for an ultimate capacity approximating 250,000 kw. is in service. The station was installed by the Public Service Company of Northern Illinois to take care of the growth in load from the northern limits of Chicago to the Wisconsin line. Covering the local area does not fully express the function of the plant. Eventually, it will be one of the big units of a great system serving all Northern Illinois outside of Chicago. The various stations will be tied together by a 132,000-volt overhead tower line. The initial span of this line to Evanston is now nearing completion, where step-down transformers are installed for interconnection with the stations of the Commonwealth Edison Company. Outside of this high-tension line and the 12,000-volt local feeders all energy leaves the station at 33,000 volts to the various distributing centers. Essentially, then, the plant will be a base-load station with economy as the first requisite. Interconnection with other plants obviates to a certain extent the need for duplication of equipment and the customary reserve, so that, generally, a simple unit plan has been followed in the station layout.

To give some idea of the extent of the service rendered by the company, it may be stated that the area for which it provides electric light and power and gas services, and in several instances, water and heat, consists of 5,825 square miles in fifteen counties. It is served by sixteen electric generating stations, both steam and hydro-electric, seven gas plants and thirty electric substations. The officers are Samuel Insull, chairman of the Board of Directors; Britton I. Budd, president; John H. Gulick, Julius L. Hecht and John T. Learned, vice-presidents.

A general conception of the ultimate layout of the plant may be obtained from Fig. 7. The location is on the lake front where plenty of good water is available for boilers and condensers and the railway facilities for coal delivery are of the best.

The plant has been arranged north and south, with the boiler room on the east side, the turbine room next to it and the switchhouse along the west side. The unit arrangement is evident. The boilers serving a respective turbine are arranged in a single row crosswise of the boiler room, These boilers, with those of the next unit, face on a central firing aisle. The plan is to build the station in two-unit sections, each practically independent of the others, although there will be electrical and steam interconnection, and already provision has been made in the water supply and in the coal-handling facilities for the entire plant. The building for the first two-unit section is complete, with the first unit in operation and the second to be installed at an early date. The other sections will follow as the growth of the load demands.

On Sept. 1, 1922, ground was broken on the new site and the initial section of the station was delivering electrical energy to the system on Oct. 11, 1923. This speaks well for the construction department of the company, under J. M. Lee.

The amount of the present load and the installed capacities at the other stations determined the capacity of the first turbo-generator as 25,000 kw. at 90 per cent power factor. Three boilers were provided to supply this unit, each containing 14,086 sq.ft. of steam-making surface. Two of the boilers carry full load on the turbine, thus giving a kilowatt on 1.13 sq.ft. of boiler surface. From previous publicity[1] in these columns it will be recalled that these boilers were designed for a steam pressure of 400 lb. and a steam temperature of 700 deg. They are operated to give a steam pressure and temperature of 350 lb. and 675 deg. F., respectively, at the turbine throttle.

In the design of the boiler some radical departures were made from former practice, and it may be said that this same type has been adopted since for a number of plants for pressures up to 600 lb. The boilers

[1] See *Power*, Sept. 12, 1922, p. 417.

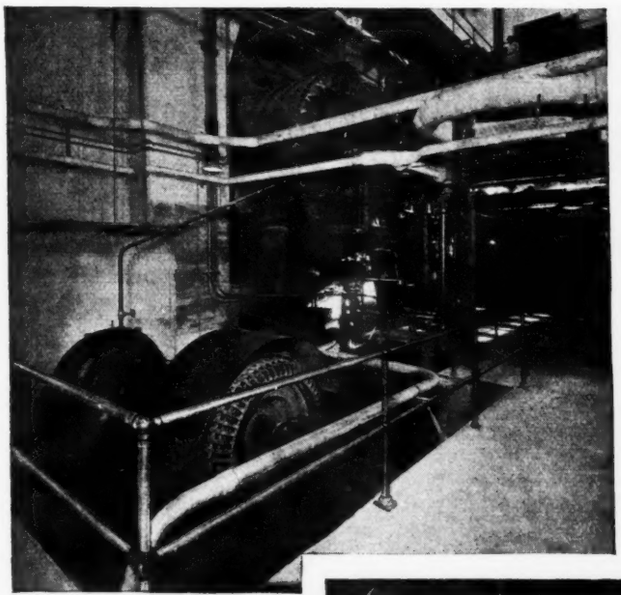


Fig. 2 (above)—Condenser head and motor-driven circulating pump

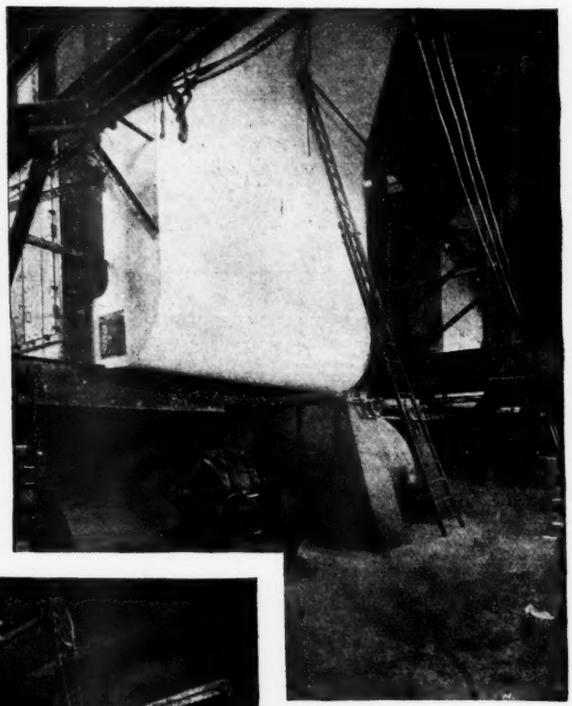


Fig. 4 (above) — Forced-draft fans and uptakes

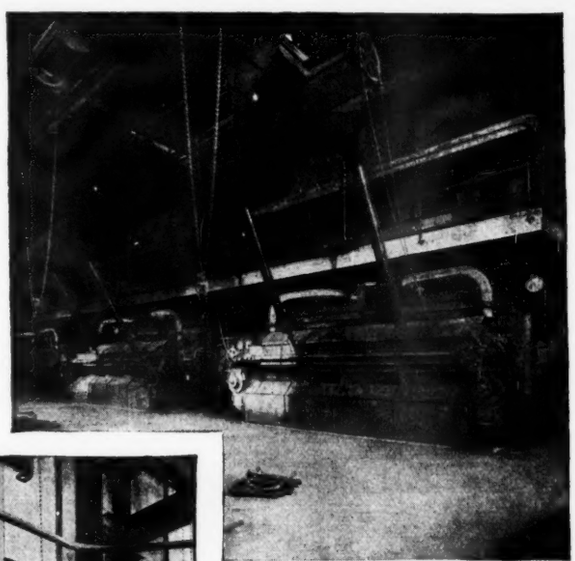


Fig. 5 (left)—Two of the three boilers serving first 25,000-kw. unit

Fig. 3 (below).— Stoker and fan control and the draft gages

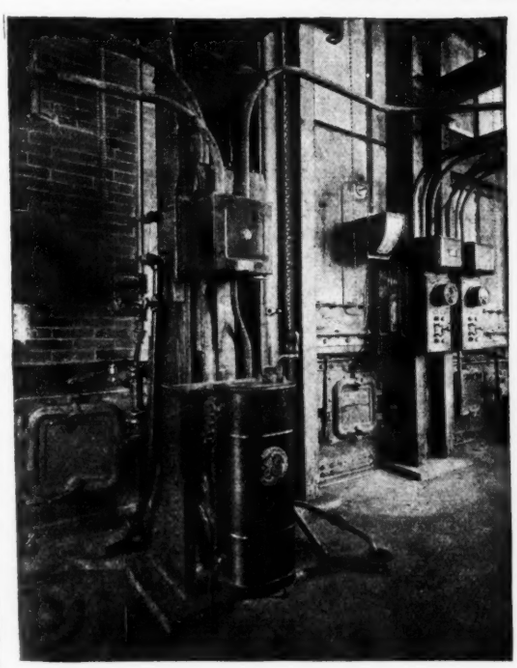
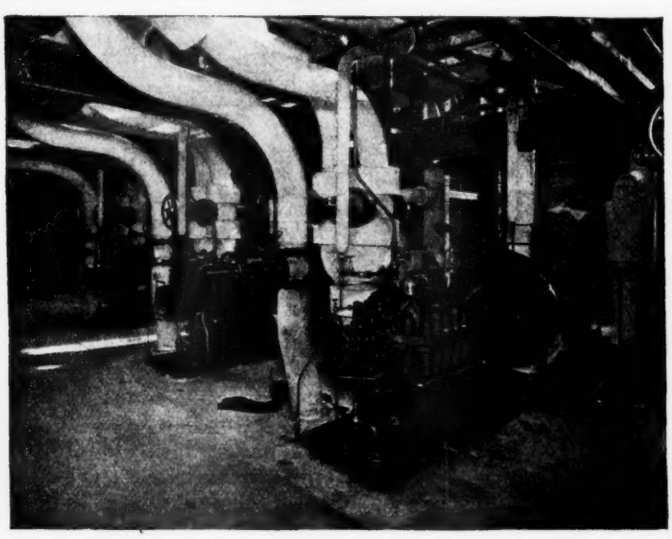


Fig. 6 (below) — Three 500-g.p.m. boiler-feed pumps



Here and There in the Waukegan Station

are of the inclined header type, 34 sections wide, with the tubes of each section arranged in two banks with sufficient space between for the superheater. The lower deck, made up of 3½-in. tubes, is exposed for its full length to the radiant energy of the fire and, being without baffles, provides a relatively large area for the passage of the gases, thus slowing down the velocity bottom, the operation is counterflow, so that with proper gas and water velocities maximum heat transfer is obtainable. Beyond the economizer space has been left for an air preheater, but at the present writing this equipment has not been installed.

An induced-draft fan operated by a variable-speed alternating-current motor, with remote control carried

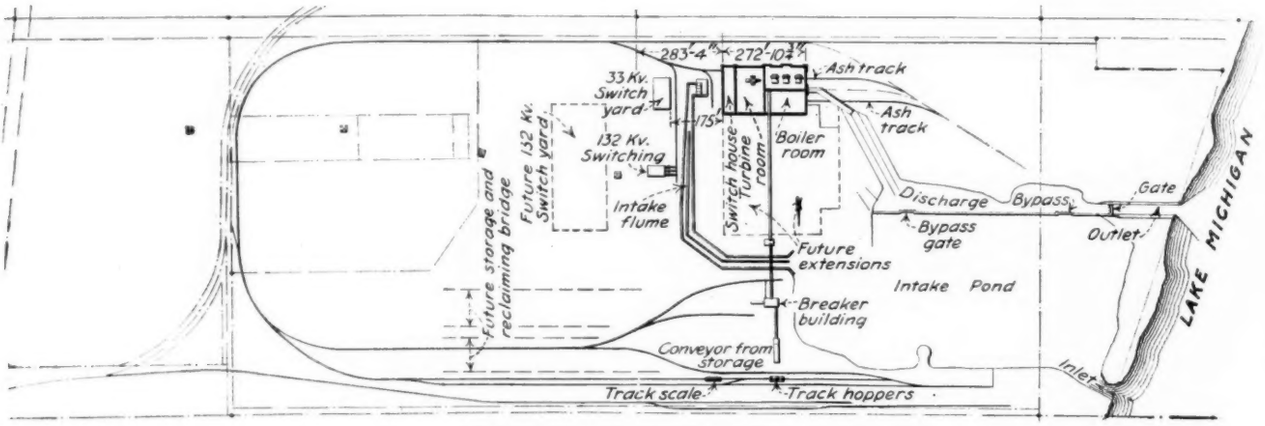


Fig. 7—Property plat for new Waukegan Station

and lessening the tendency for the clinker to adhere to the lower tubes. The upper bank of 2-in. tubes has a single baffle providing two passes for the gases, so that the outlet into the individual economizer serving the boiler is between the two banks of tubes.

With the superheater located nearer the fire, relatively less area was required to produce the 250 deg. of superheat desired. The actual surface installed in

to the boiler front at the floor level, draws the gases from the economizer and delivers them to the smoke flue passing over the boiler-room roof to the steel stack serving the three boilers. To reduce radiation and to protect the metal, the flue is lined with gunite and the stack with brick. The latter is 16 ft. in diameter at the top and rises 150 ft. above the boiler-room floor level, or about 90 ft. above the roof.

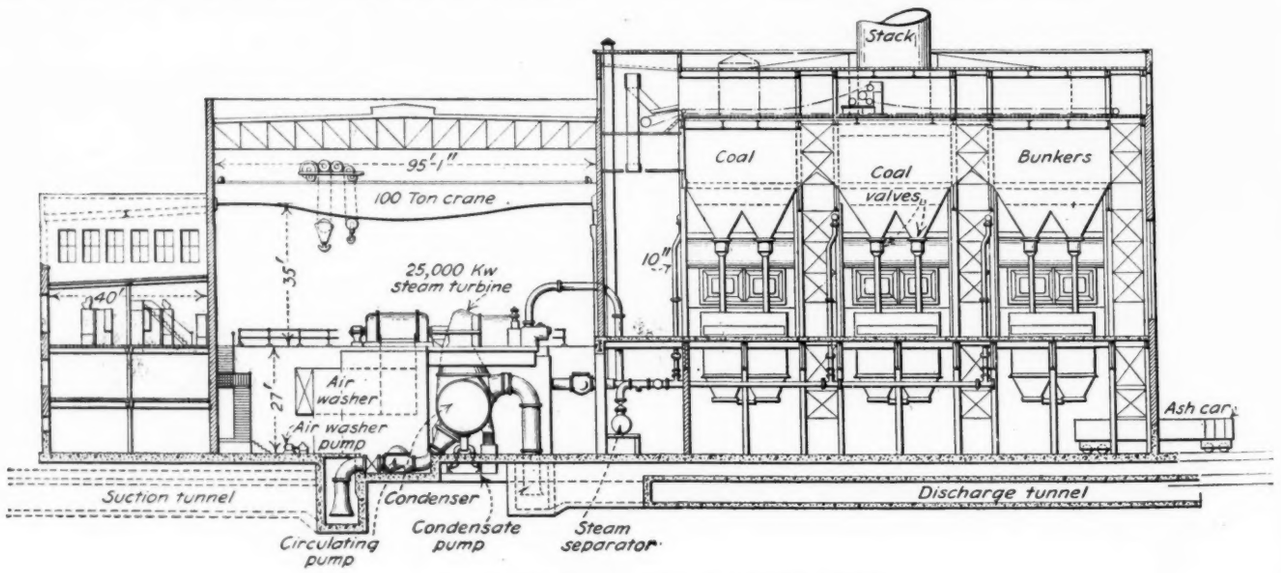


Fig. 8—Transverse section through plant

the three rows of 2-in. superheater loops is 2,286 sq.ft., aproximating one-sixth of the boiler-heating surface. With 8,837 sq.ft. the economizer has almost two-thirds as much surface as the boiler. It is of the transverse-tube design, made up of 36 sections in height, each containing twenty 2-in. tubes, 20 ft. long, connected by wrought-steel headers. With the feed water entering at the bottom and traveling upward from row to row and the gases flowing in a single pass from top to

For normal operation each boiler has been designed to deliver 100,000 to 120,000 lb. of steam per hour and 150,000 lb. under maximum conditions. This is equivalent to an evaporation per square foot of steam-making surface ranging from 7 to nearly 11 lb., which, in other words, means operation between 200 and almost 400 per cent of rating. To operate efficiently under these conditions while burning Southern Illinois coal containing approximately 11,000 B.t.u., per pound and almost

11 per cent ash, requires a furnace of large volume. This was provided by moving the bridge wall back to serve as the rear wall of the setting and raising the boiler to an average height of 16 ft. 8 in. from the grate to the bottom of the lower tubes. A primary combustion volume of 4,300 cu.ft., including the space under the arch, was obtained, and this figure reduces to 0.305 cu.ft. of furnace volume per square foot of steam-making surface.

Large coal-burning capacity was secured by installing under each boiler a five-zone forced-draft chain grate, having a grate area of 383 sq.ft. and a ratio to the steam-making surface of approximately 1 to 37. These stokers have the distinction of being the first and the only chain-grate stokers to be driven by alternating-current motors. They are of the standard, variable-speed, wound-rotor, open type, rated at 10 hp. and regulated by a ten-point controller. This subdivision of the controller and a four-speed gear box make it possible to drive the stoker at 40 different speeds, so that a grate travel ranging from 2 to 14 in. per minute may be obtained. A belt between the gear box and the stoker drive gives the flexibility necessary to guard against breakage.

The forced-draft fans are behind the boilers on the boiler-room floor. Each fan serves its individual boiler, and to avoid complication, there is no interconnection between units. Without the fans the boilers can operate approximately at 50 per cent of normal capacity, so that the interchangeable feature common in many plants was not considered essential. As with the induced-draft fan motors, the control is of the remote type with a motor-operated regulator functioning at the will of the operator through a push-and-pull control on the operating panel at the boiler front.

Double-gated ash hoppers lined with firebrick serve each boiler. Their capacity of 37 tons each is sufficient to carry the boiler over a 24-hour run. Through specially cast gates with gutters around the sides to drain off the water, the ashes are delivered directly into standard railway cars operating on a track at grade level under the boilers.

All high-pressure steam piping is of steel, double extra heavy, with steel fittings and valves and welded joints. The header for the present boilers is carried in a gallery under the boiler-room floor. It will be interconnected with the headers for succeeding units, with motor-operated valves in the cross lines. From the boilers 10-in. leads drop down to the header. The stop valves are motor-operated, with remote control, and in the header before the steam separator is a hydraulically operated valve arranged for remote control from different parts of the plant, in order that the entire system may be closed down at once in case of an emergency.

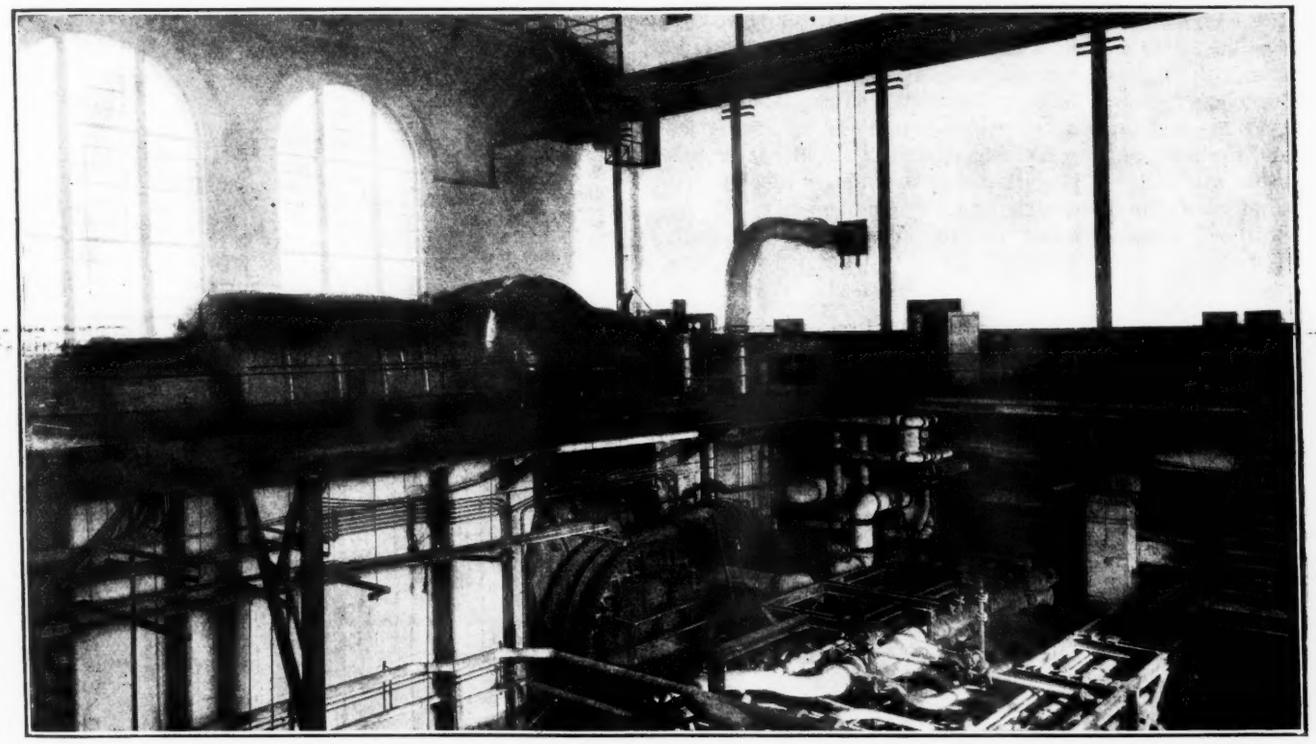


Fig. 9—Main generating unit, 25,000 kw. with pump piping and condenser head in foreground

Although there is future provision for a car dumper and a storage and reclaiming bridge with belt conveyors to convey the coal to and from storage, the present arrangement is to weigh the coal on a track scale and dump it into a track hopper from which it is carried by a single 36-in. belt conveyor to the breaker building, 200 ft. distant. At present the building contains a single Bradford breaker of 150 tons capacity per hour. This will be sufficient for the first four units of the station, but for the ultimate plant a second breaker will be required. In order that the coal-handling system may not be disturbed as additions are made to the plant, the breaker building is far enough back from the final southern limit of the boiler room to permit the belt conveyor carrying the coal to reach an elevation of 85 ft. to the top of the plant, which it does at the maximum

grade of 18 deg. with the horizontal. The belt conveyor comes into a junction tower just outside of the final boiler-room wall and continues along the side of the boiler room for the full length to deliver onto cross belts supplying the overhead bunkers. These bunkers, which are to be placed over the firing aisles to serve adjacent rows of boilers, will have a capacity of 175 tons per boiler, or about a 24-hour supply at the rate of operation anticipated. From the bunkers two swinging spouts per boiler deliver the coal to the stoker hoppers. No provision is made for weighing the coal in the boiler room, but a weightometer has been placed in the belt conveyor between the breaker house and the boiler room.

The feed-water system for the plant is shown diagrammatically in Fig. 10. Essentially, it consists of two extraction heaters, one receiving steam from the turbine at about 4 lb. and the other at about 18 lb. absolute. A third port has been arranged in the turbine for bleeding at 47 lb., but is not utilized at present. To heat the makeup water with the steam from auxiliaries and the low-pressure heating system, a third heater has been provided. It is equipped with a steam ejector and condenser for removing the non-condensible vapors. Softened makeup water for the plant passes through

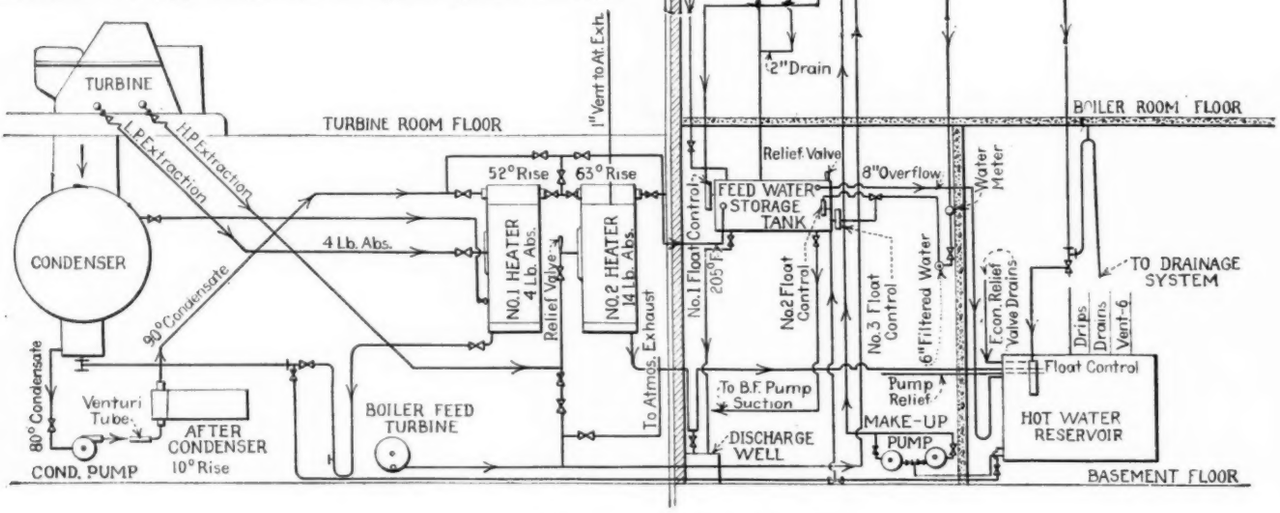


Fig. 10—Diagram of feed-water system

this condenser into a 10,000-gal. hot-water reservoir which also receives the high- and low-pressure drips and drains.

Following the diagram, it will be seen that the condensate pump, drawing from the hotwell of the main condenser, forces the condensate first through the after-condenser of the steam-jet air pumps, then through the two extraction heaters in series to a 6,000-gal. feed-water storage tank, forming the suction for the boiler-feed pumps. This storage tank has three float controls. The first control regulates the operation of the makeup pumps which draw from the hot-water reservoir and deliver through feed-water heater No. 3 to the feed-water storage tank. The second float control opens a valve in a line between the main condenser hotwell and the hot-water reservoir from which the supply gets into the feed-water storage tank in the usual manner. The third float control admits to the feed-water storage tank cold water from the service water supply.

As the original supply of boiler water comes from the cooling-water discharge tunnel, it is lake water containing about 7 grams of encrusting solids per gallon. Although the scale content is low, it was thought advisable to minimize the scale forming matter entering the boilers.

A zeolite system having a capacity of 7,500 gal. per hour was installed to reduce the makeup water to zero hardness and thus obviate scale trouble.

Reference to the diagram will show that either or both extraction heaters may be bypassed, that the condensate from heater No. 1 drains to the condenser hotwell, while the condensate from heater No. 2 goes to the hot-water reservoir. To this same reservoir the feed-water storage tank may overflow.

For the boilers of the initial installation there are three 500 gal. per min. boiler-feed pumps, two turbine-driven and the other connected directly to a motor. At present one pump meets the requirements for the most part, although upon occasion two pumps are used. Variation between turbine or motor drive is made to maintain the heat balance of the plant. There is one 500 gal. per min. boiler washer and fire pump and one of the two 750 gal. per min. service pumps is steam driven. All the other auxiliaries in the station, except the condenser steam-jet air evactors, are motor operated.

Special Features of Turbine

In the generating room the main unit is of new design. The aim was to produce a highly efficient machine without departing more than necessary from late standard practice that has been tried out in service in smaller units. For example, the maximum length of blade and the maximum diameter of spindle are no greater than in a 10,000-kw. machine.

In effect the turbine is a four-bearing single-cylinder machine with double-flow exhaust blading. The steam is expanded through the turbine in the usual manner, down to a point where the pressure aproximates 5 lb. Here the steam flow is divided so that one-half of it is

diverted around the first section of the low-pressure blading and admitted to a supplementary cylinder in the exhaust nozzle; see the cross-section, Fig. 11.

Both sections of the low-pressure element discharge in the same direction. That part of the end thrust of the spindle not counteracted by two balance pistons is taken by a Kingsbury thrust bearing. To minimize leakage over the blades, the first and second stages are provided with axial baffling while the balance of the blading has standard radial baffles. Other points of construction, including the governor and the oil-relay system for controlling the inlet valve, are much the same as in the smaller machines. The blading of the turbine was proportioned for 350 lb. steam pressure, 240 deg. superheat and 29 in. vacuum, while the machine itself was built to withstand a working pressure of 400 lb. gage and a total steam temperature of 700 deg. F.

The generator, which is rated at 25,000 kw. at 90 per cent power factor, 12,000 volts, 1,800 r.p.m., 60 cycles, in diameter, bolted together, with no longitudinal joints. The water-boxes have the unusual depths of 4 and 3 ft. respectively, and the end covers are provided with an unusual number of inspection doors. The condenser is bolted directly to the exhaust nozzle of the turbine and is supported on springs. Cooling water is supplied by one 36-in. circulating pump, driven by a 300-hp. two-speed alternating-current motor at 435 or 390 r.p.m. Its capacity against a 25-ft. head at the high speed is 35,000 gal. per min.

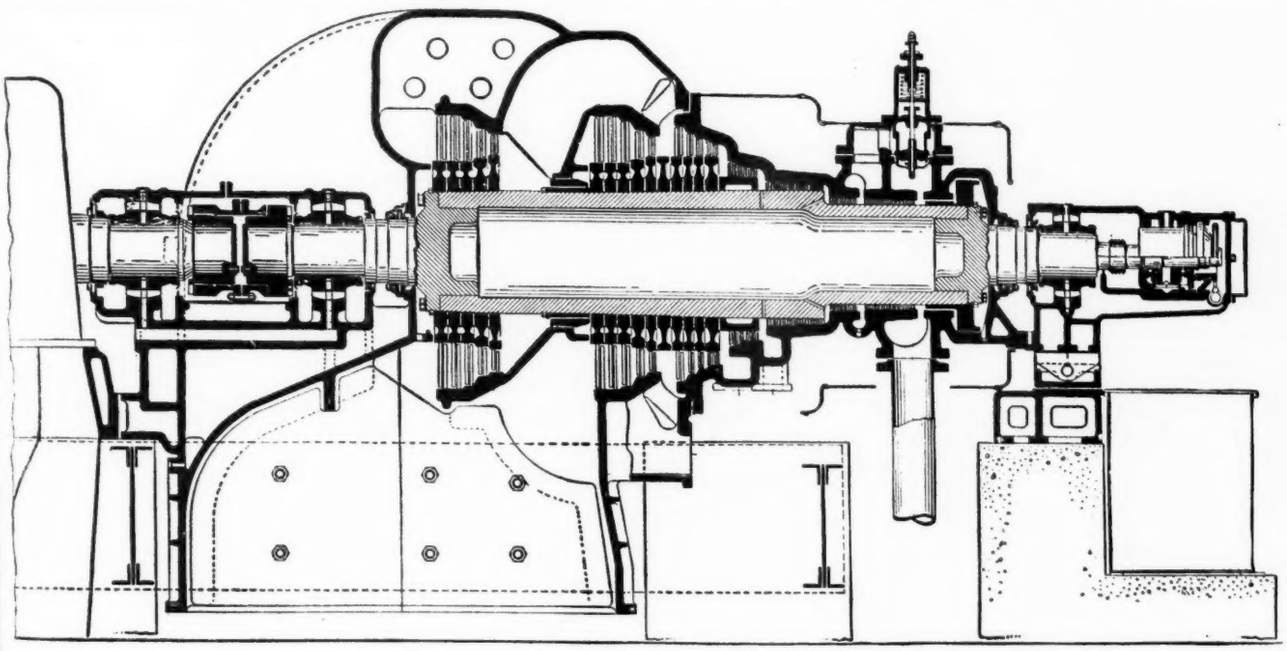


Fig. 11—Section through 25,000-kw. turbine

Electrical Features

Both ends of each phase of the generator windings are brought out through current transformers which are differentially connected for balanced relay protection, the relays tripping the generator and field switches and the neutral oil switch and closing the bus reactor short-circuiting breaker. Static arresters on each generator lead guard the generator and bus against switching surges. The control for the generator is effected by regulating the voltage of the exciter through a contact-making voltmeter functioning in connection with a motor-operated rheostat. Through selective oil switches current from the machine passes to either the main or the reserve bus. As additional units go in, the ultimate plan is for a ring bus with a reactor between each two sections shunted by a reactor short-circuiting breaker interlocked electrically with the generator oil switch.

In the station all auxiliary motors, aggregating 2,000 hp., are driven from the 480-volt bus although space has been left for a 2,300-volt bus, and in the future it is probable that the larger motors will be operated at this voltage. For the 480-volt oil switches there is no general control board. The larger motors have individual oil switches with the control at the motor or some convenient location. A feature for the smaller motors is grouped feed from single oil switches to control panels on which are mounted inclosed safety switches for the various motors of the group.

is in general of standard construction. Stator ventilation is of the inward-outward radial-flow type in which the air is subdivided into a number of parallel paths. Cold air is delivered back of the stator core and reaches all parts so that the middle sections are cooled as effectively as those at the end. Approximately 70,000 cu.ft. of air per minute is supplied by centrifugal fans mounted at each end of the rotor. This air is cooled by an air washer arranged for operating on a closed system. A 250-volt exciter mounted on the generator shaft, has sufficient capacity for the excitation of two main units. The storage battery in the station is used only for control and emergency lighting.

The condenser serving the main unit is of the two-pass horizontal surface type containing 32,000 sq.ft. of cooling surface, a provision of 1.28 sq.ft. per kilowatt of unit rating. When condensing 220,000 lb. of steam per hour with 70-deg. cooling water, it is designed to give a pressure of 1.6 in. absolute. The surface is made up of 1-in. o.d. tubes, 20 ft. 3 in. long. The shell of the condenser is divided into four cylindrical sections, 12 ft.

DATA ON MECHANICAL AND ELECTRICAL EQUIPMENT IN WAUKEGAN STATION, PUBLIC SERVICE COMPANY OF NORTHERN ILLINOIS

GENERAL

Consulting Engineers	Sargent & Lundy
Architect	H. V. Von Holst
Date of initial operation	October, 1923
Location of plant	Waukegan, Ill.
Character of service	Light and power
Capacity of generating unit, kw. at 90 per cent p.f.	25,000
Boilers installed	3
Turbine room (for two units)	96 ft. x 155 ft. 6 in.
Boiler room (for six boilers)	137 ft. x 155 ft. 6 in.
Distance from condenser floor to turbine platform, ft.	27
Distance from ash track to boiler room floor, ft.	29
Distance between boilers	12 ft. 4 in.
Firing aisle at right angles to length of turbine room	

BOILERS AND SUPERHEATERS

Manufacturer	Babcock & Wilcox Co.
Type	Inclined header, cross-drum
Number installed	3
Steam-making surface per boiler, sq.ft.	14,086
Grate area per boiler (18 ft. 3 in. x 21 ft.), sq.ft.	383
Ratio of grate area to boiler heating surface	1 to 37
Furnace volume, cu.ft.	4,300
Size of tubes, (18 rows in lower deck), in.	3¼
(17 rows in upper deck), in.	2
Designed for boiler pressure, lb. gage	400
Type of superheater	Integral
Manufacturer	Babcock & Wilcox Co.
Location of superheater	Between upper and lower deck
Superheating surface, sq.ft.	2,286
Total steam temperature, deg F.	700

STOKERS

Manufacturer	Babcock & Wilcox Co.
Type	Forced draft chain grate
Number of stokers (one per boiler)	3
Number of air zones per stoker	5
Grate area per stoker, sq.ft.	383
Drive of stoker, a.c. var.-speed motor, hp.	10
Arch, radial end	M. H. Detrick Co.
Width of arch, ft.-in.	21-6

ECONOMIZERS

Manufacturer	Babcock & Wilcox Co
Type	"Duratex"
Location	Rear of boiler
Heating surface, sq.ft.	8,837

DRAFT EQUIPMENT

	Induced	Forced
Manufacturer	American Blower Co.	American Blower Co.
Type	Double inlet	Double inlet
Capacity, cu.ft. per min.	92,000 each (at 350 deg. F.)	60,000 each
Number of fans	One per boiler	One per boiler
Drive, motors, 440-v. variable speed	A.C.-150 hp.	75 hp.

CHIMNEY

Type	Steel, brick lined
Number of boilers per stack	3
Height above grate	146 ft. 8 in.
Diameter at top, inside, ft.	16
How supported	Building steelwork

MISCELLANEOUS EQUIPMENT

No.	Equipment	Type	Size	Manufacturer
1	Boiler wash and fire pump	3-stg. tur. driven	500 g.p.m.	A. S. Cameron Steam Pump Works
2	Extraction heaters	Str. tube, closed	14,80 sq.ft.	Ross Heater & Mfg. Co.
1	Makeup heater	Str. tube closed	220 sq.ft.	Ross Heater & Mfg. Co.
3	Boiler goot blowers	Valve in head	22 units per boiler	Diamond Power Specialty Co.
1	Water softener	Zeolite	7,500 gal. per hr.	Permutit Co.
2	Makeup pumps	Single-stage, motor Dr.	50 gal. per min.	Allis-Chalmers Mfg. Co.
1	Air Compressor	Self-contained	225 cu.ft. per min.	Westinghouse Traction Brake Co.
1	Turbine-room crane	4 a.c. motors, 440-volt	100 tons	Whiting Corporation

VALVES, METERS, PIPINGS, ETC.

Equipment	Manufacturer
Feed pump governors and drainage control	S. C. Regulator Mfg. Co.
Feed-water regulators	Northern Equipment Co.
Safety valves	Consolidated Safety Valve Co.
Blowoff valves	Edward Valve & Mfg. Co.
High-pressure steam gate valves and piping	Edward Valve & Mfg. Co.
Sargol welded joints	Crane Co.
Pipe covering	Johns-Manville, Inc.
Draft gages	(Lewis M. Ellison) (Bailey Meter Co.)
Indicating steam gages	Crosby Steam Gage & Valve Co.
Recording thermometers	The Foxboro Co., Inc.
Feed-water meters (Venturi)	Builders Iron Foundry
Steam-air flow meters	Bailey Meter Co.

COAL HANDLING

To and from storage piles by 20-ton locomotive cranes, 140 tons per hour	Browning Co.
From cars to bunkers by belt conveyor system, 140 tons per hour, built by	Koppers Co.
Track hopper to conveyor	Duplex shaking feeder
From feeder to Bradford breaker	36-in. belt conveyor
From breaker to end of boiler house above bunkers	Series of 3—24-in. belts
Distributon to bunkers	24-in. belt and tripper
Refuse from Bradford breaker	30-in. belt
Total length of belting used, ft.	2,565
Total horsepower of conveyor drive	72.5
Horsepower of breaker drive	125
Crushed coal weighed by weightometer on conveyor	
Coal in cars weighed by track scales	

HOUSE SERVICE PUMPS

Manufacturer	A.S.Cameron Steam Pump Wks
Number	2
Capacity, gal. per min.	750
Head, ft.	135
Number of stages	One
Drive	40-hp. turbine, 2,000 r.p.m. 50-hp. motor, 1,800 r.p.m.

BOILER-FEED PUMPS

Manufacturer	A.S.Cameron Steam Pump Wks.
Number	3
Capacity, gal. per min.	500
Head, lb. per sq.in.	460
Type	5-stage turbine pumps
Drive	Two 250-hp., 2,275 r.p.m. turbines One 350-hp. 1,750-r.p.m. motor

TURBO-GENERATOR

Manufacturer	Allis-Chalmers Mfg. Co.
Type	Single-cylinder reaction
Capacity, kva.	27,777
Speed, r.p.m.	1,800
Pressure at throttle, lb. per sq.in.	350
Superheat, deg. F.	240
Type of generator	3-phase, 60-cycle, 12,000-v.
Ventilating air, cu.ft.	75,000
Exciter, direct-connected, kw.	200
Air washer, 75,000 cu.ft.	Carrier Air Conditioning Co.

CONDENSER

Make	Allis-Chalmers Mfg. Co.
Type	Horizontal two-pass cylindrical
Tube surface, sq.ft.	32,000
Tubes, 1 in. o.d., No. 18, BWG	70 per cent copper, 30 per cent zinc
Circulating pump: 1 36 in. horizontal pump driven by 300 hp. 2-speed induction motor; capacity 35,000 g.p.m., 390 and 435 r.p.m.	Allis-Chalmers Mfg. Co.
Condensate pumps: 2 two-stage, 600 g.p.m., each driven by 50 hp. constant-speed induction motor	Allis-Chalmers Mfg. Co.
Air pumps: 2 two-stage, vactor steam jet; capacity 30 cu.ft. of free air each at 1 in. abs.	Croll-Reynolds Engineering Co.
Type of screens	Stationary
Manufacturer	Variety Fire Door Co.

ELECTRICAL EQUIPMENT

Electrical installation	Wm A. Pope
Main oil circuit breakers: 12,000-v., 2,000-amp., truck type	Condit Electrical Mfg. Co.
33,000-v., outdoor type	General Electric Co.
Auxiliary power oil circuit breakers: Seventeen 600-amp., remote controlled, sol. op. Two 2,000-amp., remote controlled, sol. op.	Condit Electrical Mfg. Co.
Motor-generator set for battery charging. Generator, 25-kw., 170-v., 2-wire, d.c. Motor, 40-hp., 440-v., 3-phase, 60-cycle, induction	Westinghouse Elec. & Mfg. Co.
Transformers, four 12,000/33,000-v. oil ins., water-cooled	General Electric Co.
Transformers, four 12,000/132,000-v. oil ins., water-cooled	Allis-Chalmers Mfg. Co.
Auxiliary transformers, two 1,800-kva., 13,200/480-v.	General Electric Co.
Lighting transformers, two 100-kva., 460/115-230-v.	General Electric Co.
Main disconnecting switches, 12,000 and 33,000-v.	Delta Star Electric Co.
Main current transformers, 12,000 and 33,000-v.	Westinghouse Elec. & Mfg. Co.
Main potential transformers: 13,200/110-v., 200-w., indoor	Westinghouse Elec. & Mfg. Co.
33,000/110-v., 200-w., outdoor	General Electric Co.
Storage battery, 56 cells, 125-v., 32-amp., 1-hr.	Electric Storage Battery Co.
Reactance coils, 400-amp., 111-kva.	General Electric Co.
Switchboards and instruments	Westinghouse Elec. & Mfg. Co.
Voltage reg. equip. and temp. ind. for 12/33-kv. trans.	General Electric Co.
Lightning arresters, 12, 33 and 132-kv	General Electric Co.
Feeder regulator, station lighting, 11 kva.	Westinghouse Elec. & Mfg. Co.
Switches, 132-kv.: One motor-operated, 145,000-v., 400-amp., 3 poles, s.t.	Railway & Industrial Eng. Co.
One combined 3-pole s.t. disc. sw. with 3-pole sw.gr. and choke coils on same base	Railway & Industrial Eng. Co.
Supports 12-kv. bus, unit type	Delta Star Electric Co.
Safety-switch units, group control centers	V.V. Fittings Co.
Cable	Safety Insulated Wire & Cable Co.

Transformers Connected for Operation on a Two-Phase Circuit*

By B. A. BRIGGS

TRANSFORMERS used on a two-phased system must be of the single-phase type, irrespective of whether single-phase or two-phase power transformation is to be accomplished. On three-phase circuits, single-phase or three-phase transformers may be used. Two single-phase transformers of like characteristics are used to change two-phase power at one voltage to two-phase power at another voltage. On a four-wire two-phase circuit the two transformers would be connected as individual single-phase units and all the rules that apply to single-phase circuits hold good when applied to transformers so connected.

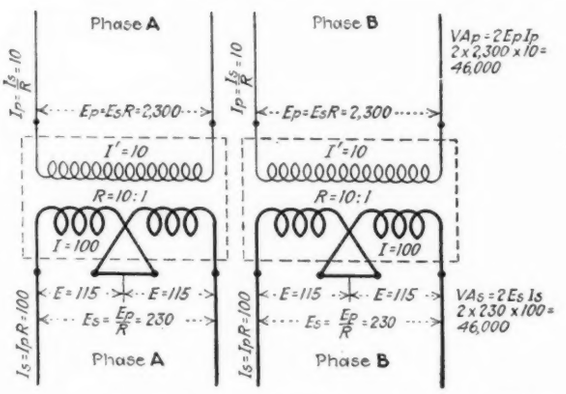


Fig. 1—Two Transformers Connected on a Two-Phase Four-Wire Circuit

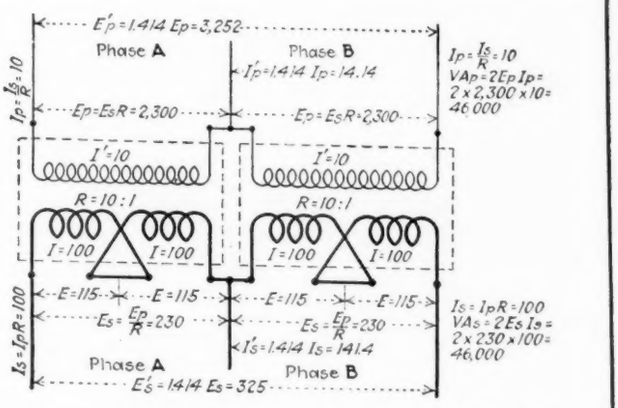


Fig. 2—Two Transformers Connected on a Two-Phase Three-Wire Circuit

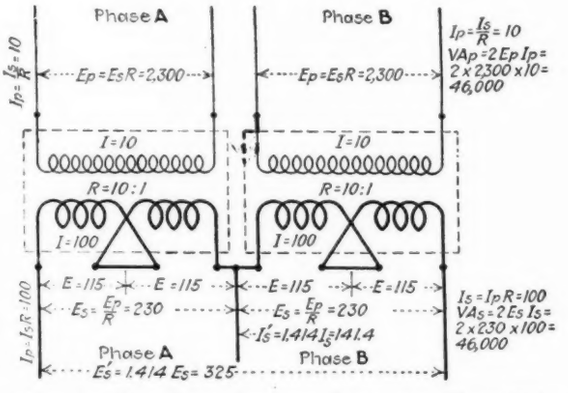


Fig. 3—Two Transformers Connected Four-Wire Two-Phase on Primary and Three-Wire on the Secondary

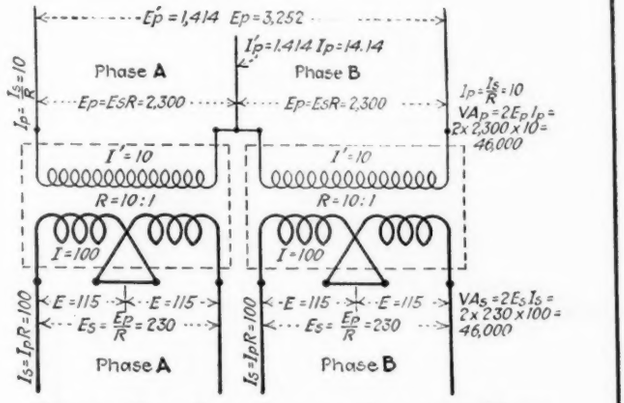


Fig. 4—Two Transformers Connected Three-Wire Two-Phase on Primary and Four-Wire on the Secondary

Fig. 1 shows two single-phase transformers connected on a four-wire two-phase circuit. It will be seen that the connections of each transformer are the same as if it were connected on a single-phase circuit, as is also the ratio of voltages and current, as explained in the articles by the author in Oct. 9 and Nov. 6 issues. The ratio of transformation has been assumed to be 10:1, therefore the secondary volts will be 1/10 the value of the primary volts and, conversely, the secondary current is 10 times the value of the primary current. The different expressions for obtaining the voltages and current are given in the diagram. The volt-amperes load on one transformer would be equal to volts time amperes. For example, on the primary side the volts are 2,300 and the current 10, therefore the volt-amperes $= 2{,}300 \times 10 = 23{,}000$. If each transformer is supplying the same amount of load—in other words, the load is balanced on the system—the load on the two transformers will be double that on one, or in this case $23{,}000 \times 2 = 46{,}000$ volt-amperes. Thus the expression $VA_p = 2E_pI_p = 2 \times 2{,}300 \times 10 = 46{,}000$ volt-amperes, which is equivalent to saying that the apparent power transmitted in a balanced two-phased circuit is equal to two times the voltage of one phase times the current of this phase. The true power

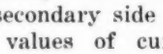
*All rights reserved.

or watts would equal the volt-amperes (apparent power) times the power factor. Where the system is unbalanced, the best way to obtain the total load would be to calculate the load on each transformer and take the sum of the two. Where the power factor is the same on both transformers, the average current can be taken as that for a balanced load in the expression, given in Fig. 1, and used to determine the volt-amperes. For example, assume that the load on one phase is 130 amperes and that on the other phase 140, the average current is $(130 + 140) \div 2 = 135$, and if the voltage on each phase is 230, the volt-amperes will equal $2 \times 230 \times 135 = 62{,}100$.

If it were desired to obtain 115 volts on the secondary side, the two sections of winding in each transformer could be connected in parallel as for any single-phase unit. This would not change the output of the transformers, since the secondary current would be doubled for a given kilovolt-ampere load.

On a great many two-phase circuits the two phases are interconnected so as to use only three wires. Fig. 2 shows two transformers connected on a three-wire two-phase system. In this connection the results will be the same as for a four-wire circuit. The current in the middle wire on a balanced two-phase load will be 1.414 time that of the outside wires. This is due to the two currents being 90 deg. out of phase with each other. On the primary side the current in the outside legs is 10 amperes; then in the middle leg it will be $10 \times 1.414 = 14.14$. This is the same rule that applies for any two-phase circuit. Likewise, the voltage between the two outside legs of the circuit is 1.414 time that of one phase. On the secondary side of the transformers, Fig. 2, the voltage E_s is 230, so that the voltage between the two outside legs is $E'_s = 1.414\ E_s = 1.414 \times 230 = 325$ volts. Examination of Figs. 1 and 2 will show that the voltage and current ratios are the same in each case. This is also true for the volt-amperes and the watts.

In some cases it may be desirable to convert a four-wire two-phase system into a three-wire. This can be done as indicated in Fig. 3, which gives a connection the same on the primary side as that in Fig. 1 and a connection on the secondary side like that in Fig. 2, with corresponding values of current and voltage. Where it is desired to change a three-wire two-phase system to one of four wires, a connection like that in Fig. 4 is used. In this figure the primary connections are the same as those in Fig. 2 and the secondary connections correspond to those in Fig. 1, and the current and voltage would be determined in the same way. In the next article the three-phase connections of single-phase transformers will be given.



During the last few years there has been a rapidly growing tendency on the part of manufacturers of electrical machinery toward the use of flexible connections between brushes and brush-holders or some portion of the brush-supporting rigging. These flexible connections are usually termed shunts or pigtails. Some of the reasons making the use of such a connection desirable are the elimination of the voltage drop between brushes and brush-holders, the prevention of the passage of load current through the tension spring of the brush-holder, the reduction of side burning and the insuring of equal distribution of current among all the brushes.

Steam Boilers

A Catechism by Warren Hilleary Served in Small Doses and Extending Over a Number of Issues

13. Why are ferrules sometimes used between tubes and tube sheets?

To fill the gap between tube and tube sheet when it is inadvisable to expand the tube to the extent sometimes required to fill the hole. These ferrules are used when the hole in the tube sheet has been unduly stretched by the expander; also, when it is desired to increase the surface contact between the tube and tube sheet and thus reduce the possibility of leakage due to the unequal expansion at this point. Ferrules are frequently used for this purpose on the firebox end of locomotive boiler tubes.

14. Of what material are ferrules generally made?

Copper.

15. Why is copper used?

Because it is pliable and not easily corroded. Its pliability enables it to fill slight depressions in either the tube or tube-sheet surface, and its non-corrosive nature prevents leakage, due to any wasting away of metal. Steel and brass are also used, but infrequently.

16. What is the method of installing a new boiler tube, assuming that the old tube had already been removed? The hole in the sheet is ⅛ in. larger than the diameter of the tube and no larger tube is available.

Preferably by inserting copper ferrules. Sometimes the tube end is heated to just a white heat, then bumped on a block of hard wood until it is upset to increase its diameter a sufficient amount, after which it is put in a lathe and turned to the desired diameter. This latter practice is not generally approved.

17. On locomotive boilers is it customary to have ferrules on the furnace ends of the tubes or on the forward ends, or on both ends?

Generally on furnace ends only.

18. Why should the rear ends of locomotive tubes be secured to the furnace tube sheet in a manner different from that followed in securing the front ends of such tubes to the forward tube sheet?

On account of the greater tendency of the furnace tube sheet to move and on account of the higher temperature of the gases where they enter the tube, it is more difficult to keep the tubes tight in the furnace ends. Hence, ferrules are generally used on the furnace end only.

19. Why are hollow staybolts sometimes used?

That they may show leaks when broken.

20. What causes such frequent breaking of locomotive-furnace staybolts?

Much greater and more rapid expansion of the furnace sheets than of the outside sheets and also because of the tendency of the furnace to move about through the jarring and vibration of moving locomotives

21. Where should the fusible plug be located in locomotive-type boilers?

In the highest point of the crown sheet, preferably near its center if only one plug is used. If two plugs are used, one should be located between eight and twelve inches from the forward end of the crown sheet and one the same distance from the rear end. If three plugs are used, one should be in the center and one eight to twelve inches from either end.

22. What is a submerged-tube vertical boiler?

One in which the water space extends above the level of the top ends of the tubes.

Spray-Pond Installation of the Fort Worth Power & Light Co.

By F. H. Rosencrants

One of the largest spray ponds in this country has recently been placed in operation by the Fort Worth Power & Light Co. at Fort Worth, Texas. The construction of this pond involves a number of features that will be of interest to engineers. The initial installation has a capacity of 133 cu.ft. of water per second (60,000 gal. per min.), and provision has been made to extend this pond to a capacity of 178 cu.ft. per second (80,000 gal. per min.). The general layout of the pond is shown in Fig. 1, and the pond in operation is shown in Fig. 2.

The nozzle groups spaced 13 ft. on centers in one direction and 26 ft. in the other direction, are made up of 7 nozzles, each having a capacity of approximately 0.07 cu.ft. per second (30 gal. per min.) when operating under a pressure of 7 lb. per sq.in. The area of the pond is such as to provide for the cooling of approximately 0.5 gal. per min. per square foot of pond surface.

Circulating water for the Fort Worth steam plant is drawn from the Trinity River. During a portion of the year the flow of the river is inadequate and recirculation of a portion of the water is, therefore, required. As laid out at the present time, the intake is at a point considerably upstream from a dam placed across the river. The discharge from the plant returns to the river just above this dam. From this it will be seen that a part of the hot water from the discharge flows over the dam, and the difference between this and the amount entering the intake will be recirculated. With the growth of load the temperature rise in the river reached a point considered prohibitive, and the decision was therefore made to install the spray pond to supplement the surface cooling already obtained in the river. The spray pumps take their suction from a point between the intake and discharge serving the condensers, and the discharge from the pond returns to the river at a point close to the condenser intake.

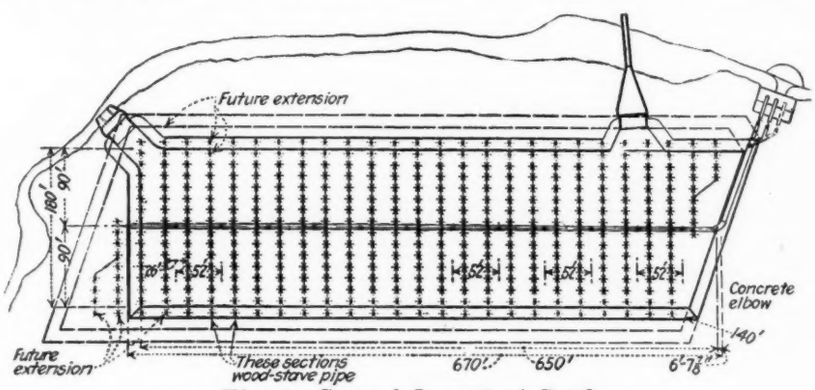


Fig. 1—General Layout of Pond

Fig. 2—Pond in Operation

Fig. 3—Shows Central Supply Line

As noted in Fig. 3, the central supply line is wood-stave construction, and a material saving as compared with either a cast iron or steel pipe was thereby effected. This line is 60 in. in diameter and is made of 2¾-in. creosoted Douglas fir staves, banded for an operating pressure of 100 ft. head. The bands themselves, together with the pipe, were given a heavy coat of California asphaltum, and as a further precaution against deterioration the entire pipe was then incased in concrete, the thickness of the concrete being approximately 6 in. and applied without reinforcing. Fig. 4 shows the form work and reinforcing in place for making a bend at the point where the main supply line from the pumps joins the line through the middle of the pond.

Most of the distributing pipe is cast iron, but as an experiment two cross lines of the pond were made of wire-wound wood-stave pipe. With the prevailing prices of cast-iron and wood-stave pipe at the time of installation there was but little saving effected. It is possible, however, to obtain prompt delivery on this character of pipe, and this, together with the ease of handling, makes it attractive for rush jobs. This section was installed purely as an experimental move, and careful observations will be taken from time to time in the hope of obtaining information as to the durability of the pipe for this service. The pipe is made of creosoted Douglas fir, and after installation a coat of

California asphaltum paint was applied, followed by a covering of 8-oz. duck securely tacked to the pipe, which in turn was finally painted with asphaltum.

The design of a large pond is always a compromise between such factors as cost of installation, character of site available and efficiency of cooling. For maximum efficiency of cooling the nozzles should probably be spaced along a single pipe line on fairly wide centers with the length of the pipe line perpendicular to the prevailing direction of the wind. It will be readily apparent, however, that such construction would be

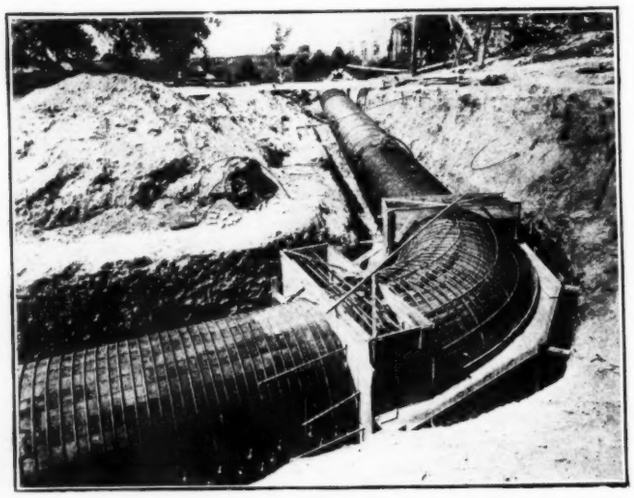


Fig. 4—Forms and Reinforcing in Place

prohibitive in cost, and there are few instances where a site is available for such construction. Such being the case, it is necessary in practice, at the expense of efficiency, to obtain greater concentration of nozzles supplied from a distribution system built on the tree system of mains and branches. Just how far this concentration of nozzles may be justified is a difficult problem to solve and one concerning which little exact information is available. The factors effecting this solution include air and water temperature, air humidity, direction and velocity of the wind, exposure of the pond —that is, whether out in the open or protected by trees, hills, buildings, etc.—value of site available, cost of materials and labor, and the value of a degree of cooling measured in terms of fuel saving.

Careful data that should be of considerable value in the design of subsequent installations are being taken at the present time on the Fort Worth Pond. At best, however, such research as is carried out on this or any other single installation, can by no means be exhaustive, but, supplemented by similar research on other ponds, forms a helpful guide in the design of future installations.

Observations on the Solid-Injection Engine

By P. H. Schweitzer

Progress of solid-injection engine design has been very distinct in the last decade, designs have been perfected and fallacious theories eliminated. The success of a solid-injection engine depends on so many variables that one cannot but wonder that the pioneer experimenters attributed the failure of certain types to the failure of the principles involved rather than to some minor difficulty. Types that were previously considered wrong in principle have been developed into successful machines. At the present time no single fundamental idea of construction has had a general acceptanse.

Usually, the historical development of machines is selective. From a large number of types one or two survive, while the others are discarded as inefficient. On the other hand, the development of the solid-injection oil engine has been just opposite to this. There are now more types than ever before. This shows that the old ideas and restrictions were wrong. But it should be clear to all that the dozen different types and principles cannot be equally good and efficient. There ought to be one or two among them, based on superior principles, which should ultimately be the most successful.

Theories and opinions concerning oil combustion are far from being uniform. The Price engine has been built with two spray nozzles opposite each other on the sides of the cylinder, with the idea that the two sprays meet in the middle of the chamber, producing a good mixture and combustion. The engine is a success. Lately, the Falk engine with a 19-in. bore has been built on this principle, and the report of the engine in *Power*, July, 1923, emphasizes this action of breaking up the spray. The sprays have to travel 9½ in. before meeting. Hesselman made calculations and came to the conclusion that an oil spray under similar conditions does not penetrate more than ⅝ in. no matter how high the initial oil pressure. He built a successful engine on this principle and caused the air to rotate in order to deliver the necessary oxygen particles to every oil particle.

H. F. Shepherd stated in a paper read before the American Society of Mechanical Engineers that he had made experiments in atmospheric air and in water and was of the opinion that the spray is able to penetrate a few inches at any rate. The writer cannot agree with him on the assumption that water offers more resistance to the spray than compressed air. It is high time to obtain positive knowledge regarding the behavior of the oil spray in compressed air.

It is a fair assumption that atomization alone, if it is carried far enough, is sufficient for combustion. The true Diesel depends almost entirely on atomization. It has been observed that the preheating of the injection oil and air causes detonations. In a solid-injection engine, if the atomization is carried to this extent, using many small holes in the nozzle, the spray will not have the energy to penetrate deep enough to meet the necessary number of oxygen particles. With more than five holes we have unfavorable results. For the same reason the use of spiral grooves to give a whirling of the spray should be discouraged.

At the German Diesel convention in 1923 Professor Alt expressed doubt about the part of vaporization in combustion. The argument was that some oils have an ignition temperature many hundred degrees higher than their boiling point. The ignition temperature of some other oils is equal to or somewhat below the boiling point. If vaporization is essential for burning, then one should expect that the higher the ignition temperature above the boiling temperature the better the combustion, because the oil and air have more opportunity to mix. No such thing has been observed.

It is known that the ignition point is determined mainly by the temperature and that compression has little effect upon it. Tizard has advocated the theory

that the ignition temperature is that temperature at which the slow combustion of the fuel vapor with air evolves heat at a slightly greater rate than it is being dissipated by conduction. Hence ignition temperature depends on the rate of loss of heat and is different in turbulent air and in stagnant air. Experiments with and without fan show differences in ignition temperature of 120 deg. F. This checks with the observation that the ignition temperature in the engine is generally higher than that measured outside.

The indicator diagrams of solid-injection engines show an explosive action. This is generally considered advantageous and essential for the dissemination of vapor. The writer believes a flatter combustion line would be desirable, provided it would not lead to afterburning. A better control of the fuel injection as to spray action and accurate delivery in quantity and timing might lead to this end.

Laying Out a Reversing Valve Gear

BY HARRY CORNELL

WHILE the majority of engineers thoroughly understand the mechanism of the slide and Corliss valve gears, few are equally versed in the action of the several reversing gears. In view of the thousands of reversing engines used in hoisting service, merchant marine and similar work, as well as locomotive service, a short method of laying out such a gear should be of interest.

There are a number of gears other than the Stephenson Link, including the Joy, Gooch, Walschaert, etc. For the purpose of demonstration the gear frequently called the Southern, but which, divested of all constructional additions, is known in different quarters as the Charles Brown, Marshall, Bremme, Klug, Wyllie and Strong, will be used.

This mechanism did not receive treatment by Auchincloss in his excellent book on "Link and Valve Motions," but Auchincloss does teach his students to lay the constituent elements of link motions in the positions desired at different crank and piston positions and to determine points of suspension and proportions that cause the valve gear to assume appropriate positions.

Referring to Fig. 1, vertical distance *D* to *E*, which is equal to twice the steam lap plus twice the lead of the valve, is ⅛ of the vertical distance *A* to *B*, which is laid out equal to the diameter of the eccentric circle. The ratio of the short division *DF* to the long division *FA* of the eccentric rod must then be 1 to 6. The bell crank *Y* is shown in the two cutoff positions, the distance *L* being equal to twice the steam lap of the inside admission valve to which it is directly connected.

With *S* and *S'* as centers the arcs *T* and *T'* are struck with a radius equal to the length of the transmission link shown in two cutoff positions as *S' D'* and *S E*.

In the mechanism shown in Fig. 1, the length of the constraining link *G* which controls the motion of the intermediate point *F* in the eccentric rod, and the radius of the arc *OW* which represents the center line of curved guide or the pivot spacing of the reverse yoke *J*, exercise a potent influence in causing either equality or in equality of cutoffs.

Robert Wyllie, whose valve gear is described in *Engineering*, Nov. 12, 1886, mentions equalizing valve travel and cutoff by the assignment of an appropriate length of the link designated in Fig. 1 as *S' D'*, but the relative positions of the valve chamber and the cylinder fix to some extent this proportion. Other designers have neglected to discuss this point.

In constructing the diagram, Fig. 1, the writer elected to lay out for inequality of cutoffs and made this inequality of greater value than practicable for the purpose of giving emphasis to the desirable qualities of a later cutoff at the back end of the cylinder than at the head end.

Some will disagree with me on this point, because a 5-in. piston rod has less than 3 per cent of the area of a 30-in. piston. But where saturated steam is used, a piston rod coming into the cylinder from the atmosphere acts more or less as a moving surface condenser.

In the layout the eccentric rod was laid in positions *AFD* and *BFE*, for front and back dead centers respectively, and in positions *A' F'' D'* and *B' F''' E*, respectively, for cutoffs at the head and back ends of the cylinder; and there were established three points *F'''*, *F* and *F''* which were considered as stations in an arc whose radius is found by locating the point of suspension *W*. This point can be found by trial arcs or by determining the intersection of bisectors as shown in Fig. 2. This determines the length of the constraining link or radius rod shown in two positions, *WF'''* and *WF'*, Fig. 1.

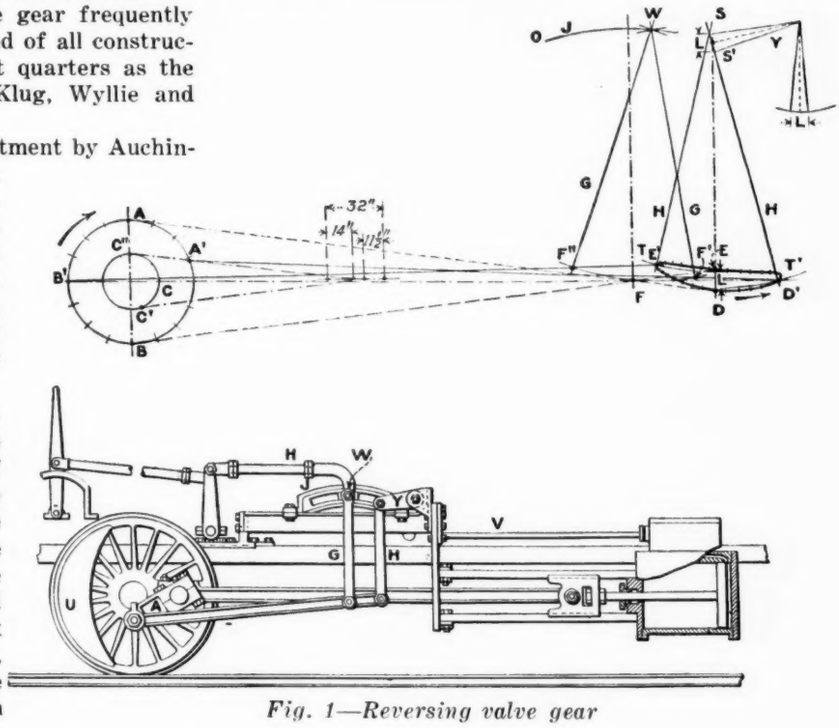


Fig. 1—Reversing valve gear

Relative to the behavior of this valve gear in locomotive service, it is adversely affected by the vertical displacement of the axle due to flexing of the spring rigging, and it has been found to set up an objectionable synchronous vibration.

When the arm *C* and the bell crank *Y* are caused to

move downward, the link *G* is in compression and there is pressure exerted on the upper face of the slot in the curved guide *J*. Where the arm *H* is caused to move upward, the link *G* is in tension; there is pressure exerted on the lower face of the curved guide *J*, and the effect of this alternate pressure upward and downward

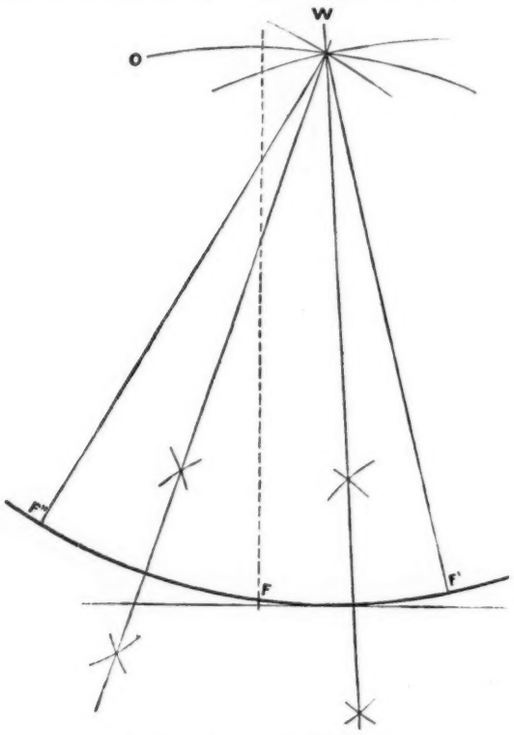


Fig. 2—Finding center of arc

is evidenced by the springing of the curved guide *J*, especially at times of poor lubrication and heavy throttle.

Power Supply for Governor Pumps

BY RALPH BROWN*

Unless the load on a hydraulic turbine closely corresponds to that percentage of gate opening to which the gates will be moved by hydrostatic pressure when the governor pressure fails the speed of the unit must necessarily increase or decrease. Even if the load was such that the gates were in the balanced position—that is, had no tendency to move when the governor pressure was reduced to zero—any change in load, or an electrical disturbance, would require a different gate opening, and as the gates could not be moved by the governor, load changes would cause the speed to vary. The usual result of a complete loss of governor pressure is that the generating units soon attain runaway speeds unless the gates can be promptly brought under control by mechanical or hydraulic hand control.

Although most hydro-electric units are designed to stand the runaway speeds to which they may be subjected due to a loss of governor pressure, it is apparent that units thus beyond control would not be available for supplying energy for commercial purposes. For this reason, and because it should always be possible to stop quickly a unit that may develop trouble, either of an electrical or mechanical nature, to prevent further damage and to limit the stresses imposed upon the rotor and runner, it is essential that the governor-pressure system be even more reliable than the excitation system.

If a central excitation system fails, a total interruption to the station affected will result, but the speeds of the generating units need not exceed their normal values unless the governor pressure is lost because of the excitation failure.

OPERATION BY STORAGE BATTERIES

If, as is the case in a few stations, ample storage-battery capacity is available for the operation of sufficient pumps to maintain the governor pressure for at least a brief period, and the motor circuit is not subjected to excessive voltage variations during normal operation, the installation of direct-current motor-driven pumps will insure a reliable source of governor pressure. When direct-current pump motors are operated from the exciter bus and no storage battery is employed, failure of the excitation system is likely to cause a loss of pressure at a time when the turbine gates should be moved to the no-load position and held there.

If, as is usually the case, the exciter turbines can be brought up to speed by a mechanical type of hand control or by a quick-acting hand pump, so that they can be operated without governor pressure at least long enough to restore this pressure to normal, direct-current pump motors are suitable, provided a reasonably constant exciter bus voltage is maintained.

When the field windings of large generators are operated in parallel with station auxiliaries, the high voltage that will appear if the field winding burns open, may play havoc with the pump motors, and for this reason lightning arresters should be installed to lessen the effects of this transient voltage.

If an exciter is connected to an alternating-current motor in a station in which a number of interconnected

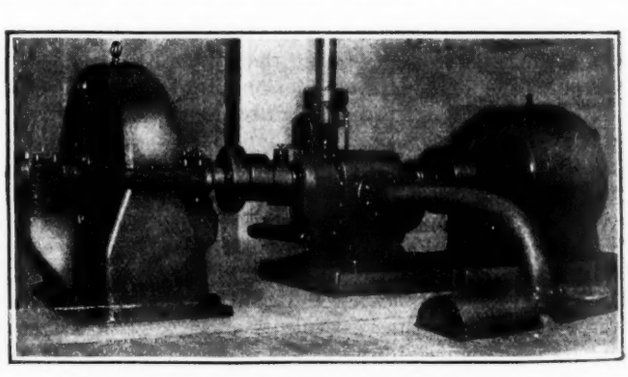


Fig. 1—Motor-drivn governor pump to which a hydraulic turbine may be connected by a clutch

transmission lines terminate, sufficient energy can usually be obtained from the transmission system to operate the exciter set, thus converting alternating current into direct current for operating the governor pumps. Hence, with a dual-driven exciter immediate attention might not need to be directed to the turbine if energy was available from any source for the operation of the motor. In those plants where generator voltage regulation is obtained by automatically varying the exciter voltage through wide limits, direct-current

*The Great Western Power Company.

motors cannot be operated from the exciter bus, and this is one of the reasons that alternating-current motors are usually employed to drive the governor pumps.

If the governor pumps are operated from a station service bus normally supplied by alternating-current generators driven by auxiliary turbines failure of the main-unit governor pressure is unlikely to occur because of any local electrical disturbance. Since the auxiliary bus is separated from the main, or generator, bus, the operation of the governor-pump motors is thus made independent of any disturbance confined to the transmission system or the main bus.

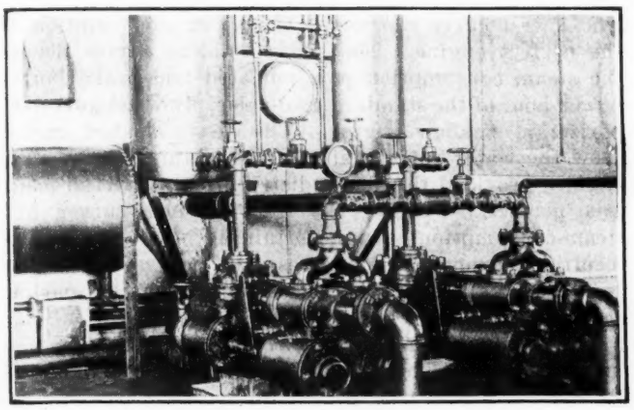


Fig. 2—Water-operated plunger pumps

By interposing a transformer between the auxiliary and main buses, the auxiliary turbines may be operated at maximum output if desired, energy in excess of that required for station auxiliaries being supplied to the main bus through the transformer. With the buses paralleled in this manner, relays should be employed to separate them in event of trouble, for without this protection any disturbance affecting the main bus would also affect the auxiliary bus. Auxiliary turbines are however, rarely employed except in the largest hydro-electric plants.

An Economical System of Governor-Pump Operation

In many stations the governor pumps are operated by alternating current obtained from the main bus, and such an arrangement is simple and cheap. But if the main bus becomes de-energized, the governor pumps will be inoperative. If the power interruption is of brief duration, it is probable that the accumulator tanks alone can supply sufficient energy to insure normal sped regulation. If, however, the pumps cannot be started within a few minutes, the governor pressure will become too low to overcome the hydrostatic pressure acting on the gates.

Cases are on record where electrical troubles, originating in the station but sometimes involving the transmission lines, have resulted in a complete loss of governor pressure. Under these conditions the rapid restoration of service was seriously handicapped because of too much dependence placed on governor pumps driven by alternating-current motors.

If water is used as governor fluid, frequently sufficient pressure can be obtained from a spring, storage tank or the penstocks to move the turbine gates in event of governor pressure failure. When such an auxiliary pressure supply is available, the turbines can be operated on hydraulic hand control independently of any pump.

Since it is not practicable to obtain sufficient pressure to move the gates by gravity when oil forms the governor fluid, an auxiliary pressure supply can best be obtained from what is usually termed a hand-control pump. If the operation of such a pump is entirely dependent upon alternating current, the hand-control pressure is likely to fail in event of a power interruption, in much the same manner as the governor pressure.

If the governor pressure fails and no auxiliary pressure is available, the only course is to move the turbine gates by some form of mechanical control or by a manually operated pump. As the efforts of one or two men may be required for fifteen minutes to close the gates on a large turbine with either type of control, this method of speed regulation is useless except for the operation of one unit for supplying power to station auxiliaries.

Considering the importance of maintaining governor pressure, as well as the danger of electrical troubles developing, the best practice appears to be to arrange the governor pumps for dual drive with a motor and turbine, unless a reliable source of power is available, such as that afforded by an auxiliary turbine or storage battery.

By coupling a small hydraulic turbine and an induction motor to the pump, the unit can be operated so that the pumping load will be assumed by the turbine in event of voltage failure, while if the supply of water to the turbine is interrupted, the load will be transferred to the motor. By selecting a well-designed turbine and passing the water through suitable strainers, there is little likelihood of the pumping load being transferred to the motor because of turbine trouble. The induction motor, however, acts as an effective governor, because it will operate as a generator if excess water is applied to the turbine and as a motor if the water supply is deficient, in either case maintaining the speed of the pumping unit nearly constant.

If the bus voltage fails at a time when excess water is applied to the turbine and no governor is provided, the speed of the pumping unit must increase and the design should be such that the unit can operate at runaway speed without damage. In many cases it will be found practicable to couple the pump, motor and turbine together without gearing of any kind, and such a combination as this will form a dependable pumping unit. Governor pumps may be arranged for turbine drive only, but in such a case the speed regulation and the desirable stand-by service afforded by the operation of an induction motor is not available.

In a few plants duplex steam pumps have been arranged to operate from penstock water, with fair results, but the low efficiency and high maintenance costs of such pumping units have apparently prevented their extensive use in hydro-electric stations.

Piping that leads air to and from the various regulating devices on air compressors deserves serious consideration. In the first place, as distances may be appreciable, it is well to provide good-sized connecting piping so that a sufficiently large volume of air may be passed to operate the regulators promptly. Nothing less than ¾-in. piping should be used even for moderate distances.

Action of Unaflow Engine Governor Eccentrics

EFFECT of Excessive Lead at Light Loads — Types of Governor Eccentrics and Influence on Lead — Variation of Lead with Change in Cutoff.

BY W. TURNWALD

MOST of the condensing high-speed unaflow engines have the common characteristic that excessive lead or too early opening of the steam valve produces a pounding in the reciprocating parts at heavy loads. The effect is most noticeable on crank- and crosshead-pin bearings and requires frequent attention. Therefore a valve-gear adjustment that will limit the lead of the valve to such an amount as to insure a quiet-running engine is necessary.

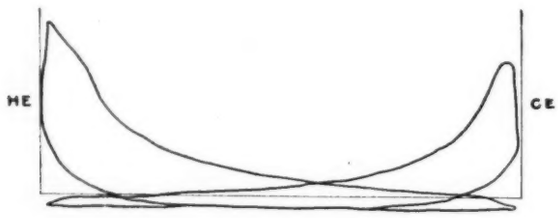


Fig. 1—Low Load Diagram of Unaflow Engine

Such an adjustment, owing to the characteristies of the governor eccentric most widely used, does not produce a satisfactory steam distribution at light loads. This condition is illustrated in Fig. 1, which represents a typical light-load indicator diagram of a condensing high-speed unaflow engine.

The admission pressure, as registered by the indicator, is not more than two-thirds of the throttle pressure at the head end and one-half that at the crank end. The cause of this very appreciable pressure drop was found in the governor eccentric, which was of the concave type and, as will be shown later, decreased both lead and lead angle with decreasing cutoff. The low final compression pressure, which in these engines rarely exceeds 80 lb. per sq.in., makes the necessity for correct valve timing more pronounced.

The natural effect of such low admission pressure is an increase in steam consumption, because the water rate obtained rightly belongs to the steam-consumption curve of the lower initial pressure. The result is, that the best point of the steam consumption curve is moved toward higher mean effective pressures without attaining as low a value as it rightfully should.

The lowest point of the steam-consumption curve of a unaflow engine, when plotted against load or mean effective pressure, is always an indication that there is a certain amount of initial condensation and other losses present. A perfect engine, or an engine with adiabatic expansion and compression, the latter of the same stroke as that of the actual engine and with a clearance volume so as to bring the final compression pressure up to initial pressure, will have a steam-consumption curve that shows a steady increase beginning with the smallest mean effective pressure. The starting point of this curve represents the steam consumption of the engine operating on the Rankine complete expansion cycle.

These conditions are shown graphically in Fig. 2. The lowest curve represents the steam consumption of the perfect engine. The heavy full-line curves denote the steam consumption per indicated and brake horsepower-hour of the standard two-valve, flywheel-governor, horizontal unaflow engine. The heavy dashed curves show the water rates that could be obtained with such engines provided the steam distribution at partial loads was perfect. Finally, the light dashed curves are steam-consumption curves, pertaining not to the engine throttle pressure, but to pressures equivalent to the dead-center pressures of the actual engine at partial loads.

The compression pressure of condensing unaflow engines does not, by a wide margin, reach the initial pressure or steam pressure at the engine throttle. As in the case of Corliss engines the pressure in the cylinder has to be built up and can be done only while the piston is at dead center and moving relatively slow. It is therefore imperative that the valve opening be timed right and that the valve open early enough to allow the pressure to build up before the piston gets under way.

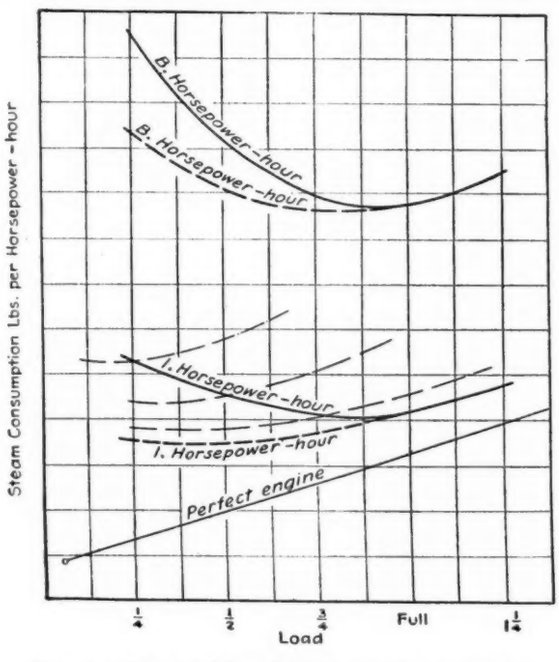


Fig. 2—Effect of Load on Steam Consumption

The terms "lead," "lead angle" and "valve opening" are illustrated in Fig. 3, which is self-explanatory. The determining feature of a governor eccentric is the eccentric center curve; that is, the curve drawn by

the center of the resultant eccentric while the governor weight moves from inside to outside position. Two such curves are shown in Figs. 4 and 5. The one termed concave, Fig. 4, is most commonly used with flywheel governors and is produced by an eccentric that is pivoted at a point relatively distant from its center. The convex curve, shown in Fig. 5, uses a primary or fixed eccentric with a secondary eccentric mounted on it, which latter is actuated by the governor.

The curves shown in Figs. 6, 7 and 8 are based on the assumption that the eccentric operates a slide or piston valve, and the effect of the angularity of either connecting or eccentric rod is ignored. It is further assumed that the ratio of maximum to minimum eccentric travel is the same in both cases, which also applies to the maximum lead.

A comparison of the two types shows that the convex type of eccentric gives a longer admission range, which in the present case is 62 per cent, as against 55 per cent. This is due to the fact that the total angle of valve opening is the same for both types, but that 8.5 deg. are taken off this angle for lead by the concave type. A slight increase of the minimum eccentric travel therefore would be possible with the convex eccentric, which would tend to improve the valve opening for early cutoff.

Turning now to Fig. 6, which shows valve opening plotted against cutoff, it will be seen that the convex type of eccentric produces a considerably larger valve opening for early cutoff. As indicated by the upper curve of the same figure, this increase in valve opening or valve lift amounts to fully 75 and 50 per cent for 10 and 20 per cent valve-gear cutoff, respectively. This in itself is a valuable feature, because it helps to improve the steam distribution.

The lead angle, or the angle through which the crank turns from the point of valve opening to dead center, is a point of most importance, because too small a lead angle or too late an opening of the valve will not allow the cylinder pressure to build up to the throttle pressure. The lead angles of the two types of eccentric are shown in Fig. 7. The concave eccentric increases the lead angle steadily with increasing cutoff. Therefore the valve opens relatively later at early cutoff. The convex eccentric gives the maximum lead angle for cutoffs between 10 and 20 per cent and gradually reduces it for

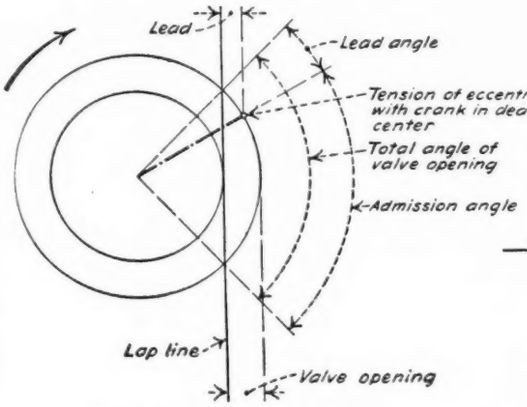


Fig. 3—Eccentric Diagram

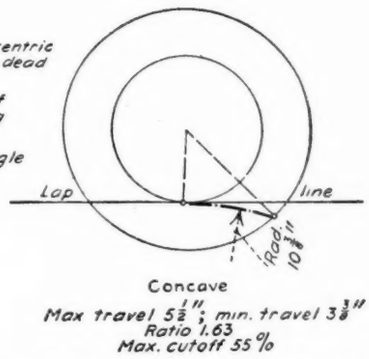


Fig. 4—Diagram of Concave Type

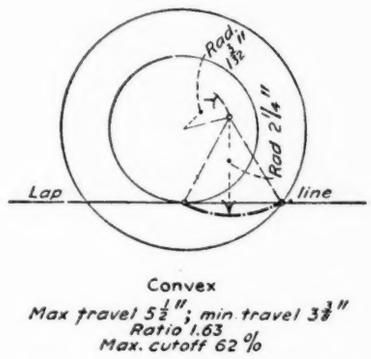


Fig. 5—Convex Type Eccentric

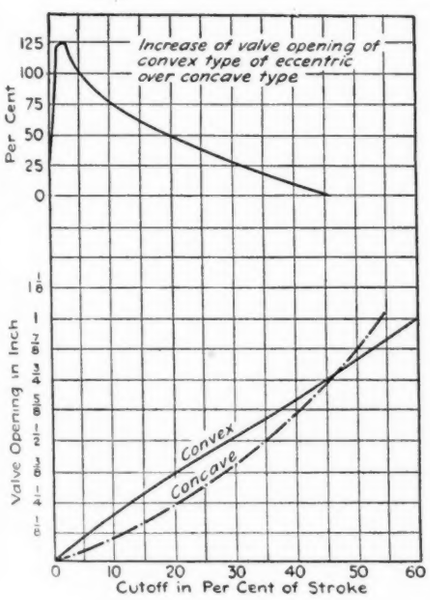

Increase of valve opening of convex type of eccentric over concave type
Per Cent
Valve Opening in Inch
Convex
Concave
Cutoff in Per Cent of Stroke

Fig. 6—Valve Opening vs. Cutoff

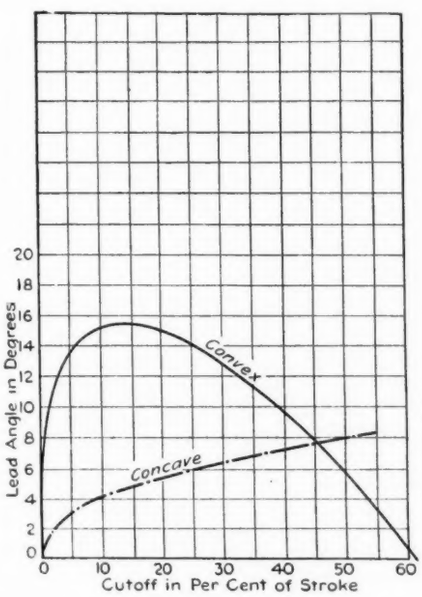


Fig. 7—Lead Angle Plotted Against Cutoff

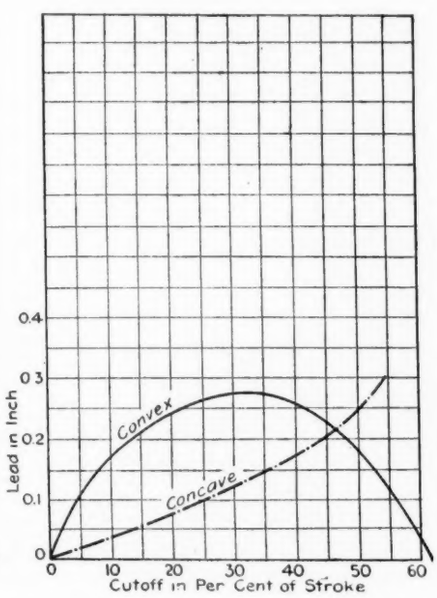


Fig. 8—Lead Inches vs. Cutoff

later cutoffs. Considering both the lead angle and valve opening, it follows that the convex type of eccentric offers the better means of obtaining full steam pressure in the cylinder at partial loads.

TABLE I—LEAD, LEAD ANGLE AND VALVE OPENING

Cutoff, Per Cent	Lead Angle, Deg. Concave	Lead Angle, Deg. Convex	Lead, Inch Concave	Lead, Inch Convex	Valve Opening, Inch Concave	Valve Opening, Inch Convex
5	3	13.5	0.02	0.1	0.05	0.1
10	4	15	0.04	0.16	0.11	0.20
15	4.6	15.5	0.05	0.21	0.17	0.28
20	5.3	15	0.07	0.24	0.24	0.36
25	5.75	14	0.09	0.26	0.31	0.43
maximum	8.5	0	0.3	0	1.06	1.06

The lead, or valve opening at dead center, as produced by the two types of eccentrics is shown in Fig. 8. Again the convex type of eccentric shows the most favorable distribution of lead over the range of admission. The maximum lead in this case is obtained at a cutoff of about 30 per cent and decreases for earlier and later cutoff. The change of lead of the concave eccentric is similar to the change in the lead angle and is undesirable.

To make a comparison easier, the accompanying table was compiled which gives valve opening, lead angle and lead for a number of different cutoffs.

An examination of the chart shows the superiority of the convex type of eccentric; if there is any possibility of accomplishing the result desired, the convex type of eccentric will offer the best chance.

Some Methods of Storing Coal

There is a prevailing impression that while coal handling and storing machines are economical for large plants, the small plant must stick to hand shoveling. This article discusses several low-priced systems.

THE science of moving articles short distances, or as it is usually termed, material handling, is of comparatively recent origin. Unfortunately, while a factory may have kept up with engineering progress by installing elevators, conveyors and shop trucks, the handling of coal, especially in small plants, is often performed in the same laborious way followed a thousand years ago.

Man is simply a power plant that converts the potential energy in the food eaten into muscular energy, and the efficiency of the plant is low. As long as the raw materials in the way of food and maintenance items, such as clothing, doctor bills, etc., were small, the operating cost of handling coal by man power was low. There were no capital charges to be carried, since when one laborer wore out, another could be obtained without any initial investment. It is little wonder, then, that the hand-operated scoop shovel long held uncontested sway as the cheapest and only feasible way to handle coal from the car into storage and finally into the boiler furnace.

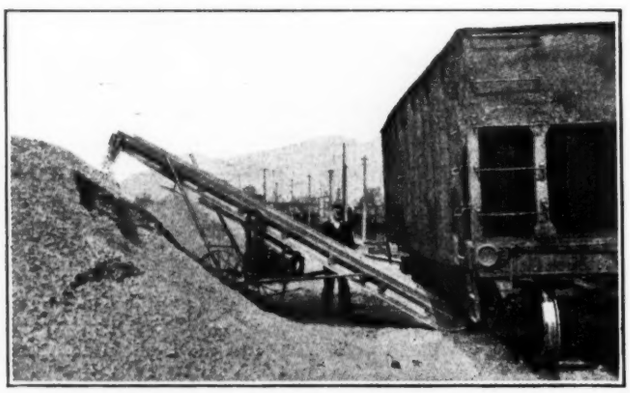


Fig. 1—Cheap method of handling coal

Hand shoveling had its defects as has all machine operations. Where coal mounted in price, it was discovered that the man machine could not compare with the mechanical stoker in making the last move of putting the coal into the furnace. So the mechanical stoker came into existence, although for a long time man still used the scoop in filling the stoker hopper from the convenient pile of coal in the boiler room.

OPERATING COST OF 18-IN. PORTABLE CONVEYOR

Plant ..... Mechanical Rubber Co.
Type of conveyor ..... Portable

Excluding Labor	
Depreciation, $900 ÷ 10 yr.	$90.00
*Average interest at 6 per cent	29.70
Maintenance and repair, estimated	50.00
Power—9 kw.-hr. per day @ $0.01 per kw.-hr. × 300 days	27.00
Total annual operating cost (excluding labor)	$196.70
Cost per day = $196.70 ÷ 300 days	$0.6556
Cost per ton = $0.6556 ÷ 46 tons	$0.0142
Including Labor	
Cost of conveyor per day	$0.6556
Cost of labor per day, 3 men 3 hours per day at $0.60 per hour	5.40
Total daily operating cost (including labor)	$6.0556
Cost per ton = $6.0556 ÷ 46	$0.1316

*Allowing for interest credited on depreciation fund.

Not until the cost of moving coal by hand began to soar by reason of the higher wages paid, the latter being made necessary by the higher charges of food and other items, did the mechanical handling of coal come into general existence. As is but natural to expect, the laborer was displaced first in the large plants where the amount of coal placed in storage or consumed was measured in thousands of tons per year. The resulting saving fully justified the substitution, and by reason of the lower handling cost per ton, storage of coal became a fixed procedure among the larger consumers.

The small plants, meaning those using less than 10,000 tons a year, have, in the main, continued to rely upon manual labor for the coal handling. The cost per ton to unload and move coal to the boiler room is high, and it is questionable whether the extra burden made necessary by storage is not greater than the factory gain resulting from having an adequate supply of coal during periods of shortage. This is for the reason that the average shoveler cannot throw coal higher than six feet. If the storage is to be of considerable tonnage, it becomes necessary either to handle the coal two or three times to pile it high or to have much ground room to enable the shoveler to stock the coal with but one handling. The latter entails some loss upon recovery by

reason of the coal mixed with dirt at the bottom of the pile.

Owners of small plants are under the impression that coal-handling machinery can be used only in large plants on account of the high initial investment. Of late years a number of machines have been designed

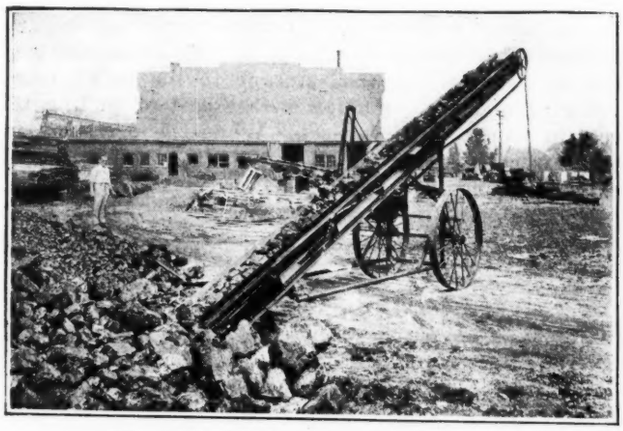


Fig. 2 Near view of portable conveyor

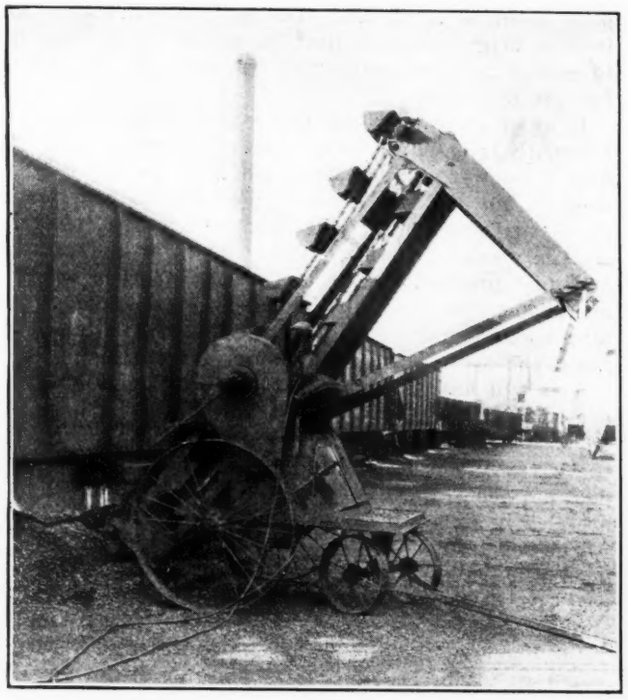


Fig. 4—Bucket and chain elevator

either specifically for the small plant or are adaptable to such.

One of the first designs of a low-priced machine to be adapted for power-plant storage was the portable conveyor, Fig. 1. The machine consists, essentially, of a belt conveyor that rests in an inclined position with the bottom in contact with the coal to be elevated. The conveyor belt, which is often provided with slats, picks up the coal and delivers it at a height of from ten to fifteen feet and at a distance of from fifteen to thirty feet dependent on the length of the conveyor.

A near view of a conveyor of this type is shown in Fig. 2. The drive is through a chain belt from either a small gas engine or an electric motor.

In case it is desired to pile the coal to a greater height, two or more such conveyors may be placed in series, as in Fig. 3. Special machines of 60-ft. span may be obtained from a number of builders.

The cost of such conveyors of course varies with the quality of workmanship, length of conveyor belt, size

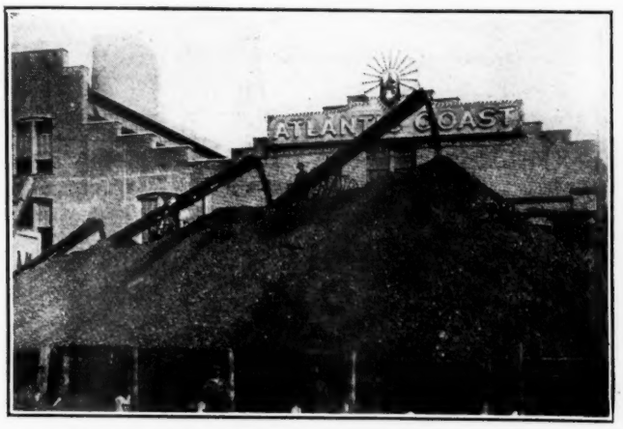


Fig. 3—Conveyors in series for high storage

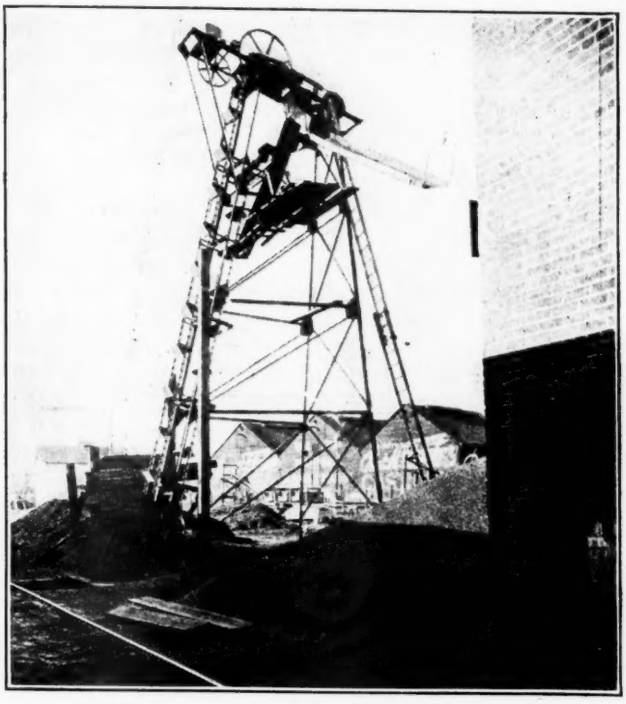


Fig. 5—Another type of bucket conveyor

of motor, etc. However, serviceable ones may be purchased for about $600, the prices ranging upward to about $800.

It is not necessary to have a hopper under the railroad track. Usually, the dumps of a hopper car are unlatched and the coal runs out as fast as the conveyor, whose base is placed against the rail, can handle the material. Operated in this manner, the conveyor will handle from 10 to 30 tons an hour.

The cost per ton of coal placed in storage will vary with the kind of coal, wage rate, amount of storage, etc. One firm reported its costs to be as given in the accompanying table.

Another type built to meet the retail coal trade's

requirements, but which has been adopted by a number of power plants, is shown in Fig. 4. This is essentially a bucket conveyor placed upon a suitable frame capable of being shifted from place to place. The drive may be any form of power available. It is apparent that the piling range is limited unless some means of

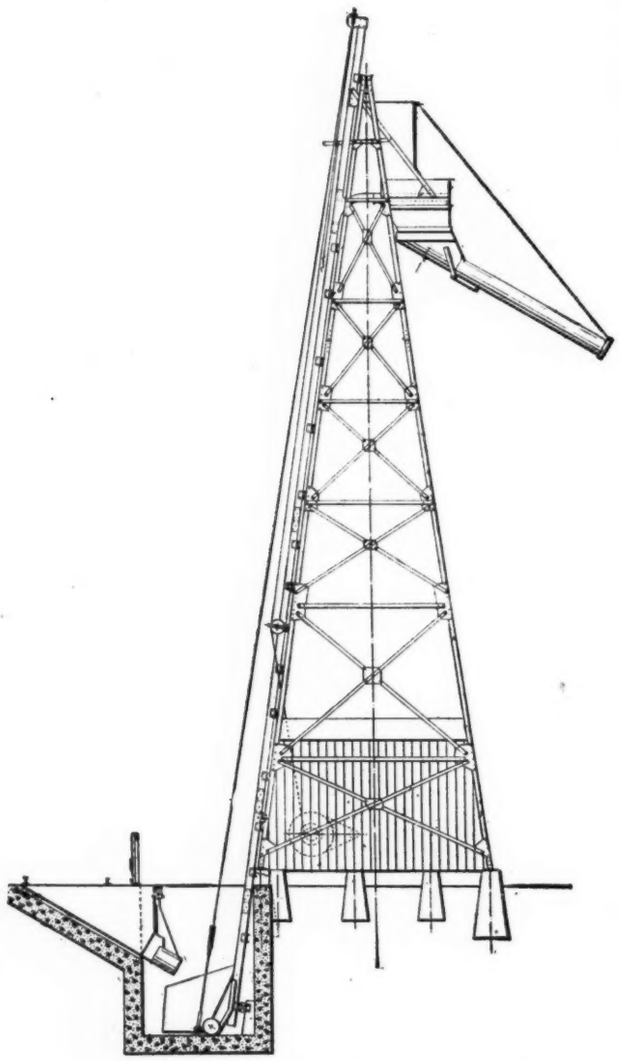


Fig. 6—Skip system for storing coal

moving the coal horizontally after being discharged from the elevator, be adopted.

A somewhat similar design, yet capable of piling a greater amount of coal, is shown in Fig. 5. This is an adaptation of the well-known bucket-and-chain elevator. A hopper with a sloping bottom is constructed under the track, enabling the coal, after being dumped from a hopper car, to flow to the elevator boot. The driving head consists of a train of gears from a 5-hp. electric motor. The coal can be discharged from either side of the head, and owing to the flexibility of the chutes the delivery range covers a considerable angle. Such a machine will cost from $800 to $1,000, depending upon the height, make, etc. The average capacity is around 20 tons an hour.

A combination of tower and skip bucket appears in Fig. 6. Here the coal is elevated by a bucket or skip; the hoisting winch is placed at the base of the tower, a gasoline engine or electric motor being used. When the skip reaches the top of the tower, its open end follows the curve of the track, the coal being dumped into the lower hopper. The coal is distributed over a wide angle through adjustment of the discharge chute.

Since low-priced conveyors are available, it would seem that no power plant can afford to risk shutdown by its failure to carry an adequate amount of storage. By reversing the arrangement of conveyors, the coal can be handled from the storage to the boiler room, bringing about a reduction in the cost of pulling the coal in front of the furnace. While the portable conveyor is not suitable for all installations, still it has an extensive range of application.

Eye Protector for the Firemen

BY C. RYE

We read much about "safety first" and possibly more about economy, yet there is a common occurrence that takes place every day in our boiler rooms that is contrary to both. We all seem to accept it as an unavoidable evil and put up with the costly result.

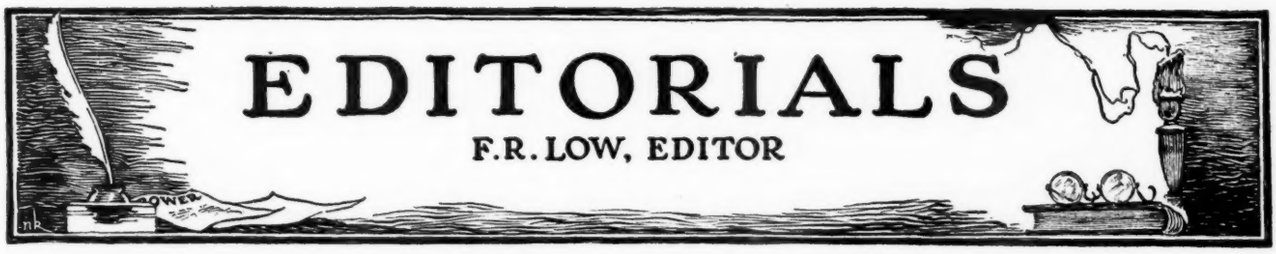
It is not unavoidable, however, and its elimination pays splendid dividends. The evil referred to is the intense brightness and heat to which the fireman has to expose his eyes every time the door of a hand-fired furnace is opened.

In an effort to eliminate this evil as much as possible, I recently tried out several types of eye protectors. The first tried were similar to those used by oxyacetylene welders, but as I was exposed to conditions which made these neither comfortable nor serviceable, I tried smoked glasses. These were next best, but perspiration and dust prevented their use. Then a green celluloid eye shade was tried with excellent results, and it has been used ever since. It allows a free circulation of air about the eyes, which is necessary for comfort.

You will find that there are several kinds of green eye shades, but the one best suited to the fireman's purpose is the kind through which you can clearly see the wires of an electric light bulb. The brilliant light does not penetrate the shade, yet all portions of the bulb are clearly seen.

The advantage of a good eye shade can hardly be overestimated, for with it the fireman can see where coal is needed, where he is putting the coal, where the clinkers are, and can remove them with the least trouble. Then, upon raising the shade, his eyes are in a normal condition to observe the water glass or steam gage on the boiler.

In operating oil fuel a study of the appearance of the furnace is a good guide to furnace efficiency. If the flame is an incandescent white and the furnace walls are clearly discernible through it, there is considerable excess air present. As the percentage of excess air is reduced, the color of the flame at the rear of the furnace becomes a pale yellow, then yellowish orange, and orange red. In general, with a well-designed installation in good condition operating with a minimum of excess air, the end of the flame farthest from the atomizers is a yellowish orange or golden shade. The gases of combustion are colorless and the seams in the brickwork are just discernible.—*From U. S. Navy Instructions.*



Higher Steam Pressures Save Little Coal

THE difficulty of generating steam-electric power with greater economy was emphasized in a number of ways at the recent convention of the A.S.M.E. Calculations which pointed out means of utilizing higher pressure and temperature cycles represented exhaustive work. Results in some cases were not strictly in accord. The existence of errors in methods of figuring were at times pointed out.

The over-all plant economy with medium pressures, around two hundred and fifty pounds, has apparently compared favorably with that of many higher pressure and temperature plants in operation at the present time.

In considering equipment for greater economy, the questions arise, How far does it pay to go with present prices? and How far will it do to anticipate future commercial conditions? Another factor is that almost every plant has special problems to meet, so that general solutions are hardly of great individual benefit. While it is theoretically possible to approach closely to the Carnot efficiency for the usual temperatures, present costs do not justify processes so efficient. Forty to fifty per cent are mentioned as possible cycle efficiencies.

The practical over-all plant efficiency, however, would be expected to be appreciably less. Even under the maximum possible conditions the wasted heat from a power plant is economically unreasonable.

The best we can expect in the near future is a kilowatt-hour per pound of coal, representing a waste of about three-quarters of the potential heat supplied by the fuel to the furnace.

The intelligent engineer cannot help reflecting upon the fact that only one-half the fuel value can eventually be utilized from the present outlook, and that about one-half of this, or only one-quarter, is practically available with the most advanced plant. Higher steam pressures are desirable at least from the relative increase of capacity and perhaps less unit cost.

In view of the difficulties of engineering the possible lack of reliability and the uncertainty of attacking the new problems, a question, naturally arises. In the pursuit of greater cyclic efficiency are we not neglecting the basic fact of saving fuel?

The stack and condenser losses are inevitable from the viewpoint of energy production. However, they represent an unwarranted waste of fuel from an economic point of view.

Little attention is paid to utilizing waste heat, compared with that of increasing the efficiency of energy production (leaving privately owned process manufacturing plants out of the question). It appears that more attention should be paid to the basic fact of efficiency utilizing fuel rather than to the extremes of efficient energy production.

How Process Plants Can Save Money

POWER has frequently called attention to the great possibilities for money saving in the average textile, paper, chemical or other hot-process manufacturing plant by a fuller understanding of the relation between heat and power and by the correct application of back-pressure or bleeder units supplying steam to the processes. The importance of this method of fuel saving cannot be overemphasized as long as so many plants continue to be wasteful in this respect. There are, however, still other ways in which process plants can save much money.

In this connection it will be well worth while for any engineer or executive concerned with a manufacturing process to read H. M. Burke's article, "How a Textile Finishing Plant Saves Steam," as abstracted on page 109. This gives the details of a remarkable fight that was made at the Mount Hope Finishing Company to lower the total fuel cost per pound of cloth in a finishing plant.

The word "fight" is used advisedly, because it alone can aptly describe the tenacity that is needed to put such a program across. In any big plant where various departments are using large quantities of steam, some at high pressure and some at low, it is a practical certainty, human nature being what it is, that much of this steam is wasted—that is, unnecessarily used. But the realization of waste is one thing and its practical prevention is another. Where the total fuel cost is simply divided up among the various departments on the basis of yardage or poundage produced, or any other basis except the correct one of charging for actual power and steam consumed by the department, it is almost impossible to secure any large and lasting gains on the consumption end.

Suppose, for example, that a certain department, which may be called department *A*, is now charged with one-fifth of the total power and heat cost of the plant, or one thousand dollars out of a total of five thousand dollars a month. Now let some relative outsider come into the department feeling that steam could be saved or that low-pressure steam could be used in place of high-pressure steam. In making this suggestion to the foreman he probably labors under the disadvantage that the foreman knows more about the particular process than does the man making the suggestion. In addition, the foreman has a natural disinclination to change his present methods. Assume, however, that the outsider is able to convince the foreman that he can save the plant as a whole five hundred dollars a month in power and heat by certain changes in operation that will not cost the particular department over one hundred dollars a month all told in other respects. The foreman sees that this five hundred dollars saving will reduce the total plant expense for power and heat to forty-five

hundred dollars a month, of which he will arbitrarily be assigned one-fifth, or nine hundred dollars. Thus, while actually producing a net saving of four hundred dollars for the plant, a stupid system of accounting will credit his department with no savings whatever. Evidently, the foreman has no incentive, beyond the company loyalty, to make any change whatever.

This point is absolutely fundamental. Any system of cost keeping that does not normally lead foremen and department heads to do the things that will save money for the company as a whole is wrong and should be changed. The only practical way to save appreciable quantities of power and steam at the consumption end is to put separate meters on the lines to the various departments and charge for the steam, electricity, hot water, etc., actually used. The minute this is done, savings will begin to appear. This was practically demonstrated at the Mount Hope plant, the savings in consumption alone amounting to twenty-five thousand dollars a year.

Ball and Roller Bearings

THE development of ball and roller bearings has helped materially to put the design and construction of bearings on a scientific and engineering basis. One of the peculiarities of these bearings is that certain features of design that have made it economically possible for this type to compete with the sleeve bearing, should have improved the latter. One of these are methods employed to keep dirt out of and the lubricant in the bearing. With the ball or roller bearing it was necessary that dirt be kept out, and means that would accomplish this also helped to keep the lubricant in. With the sleeve ring-oiled type of bearing ordinary dirt gave little trouble and apparently machine designers gave small attention to this feature. Production of lubricants became a highly developed art, while the sleeve bearing remained something that every machinery manufacturer applied in his own way.

It was not until the comparatively recent use of ball and roller types on a large scale that the design and construction of bearings became a highly developed art. Ball and roller bearing developments have resulted in taking the production of these accessories to a large degree out of the hands of the machinery manufacturer and transferring it to a few specialized organizations. The bearing problems were transferred from the machinery manufacturer to another organization, which had to be able to defend its product when trouble developed that was not attributable to the bearings. This has had a healthy effect on the whole bearing problem. Although there are phenomena of ball and roller bearings that the experts may not agree on, a great deal of scientific and engineering study has been given them and they are better understood than any other type with probably the exception of thrust bearings for heavy machinery. They have come into wide use for light and medium-sized machinery, and just at this time a great deal of attention is being centered on their application to electric motors.

The use of ball and roller bearings on motors has now passed the experimental and engineering stage, and it remains for them to prove their economic worth. To do this they must increase the reliability of the motor by reducing bearing troubles and breakdowns in the winding due to lubrication being thrown from the bearing. Operating information available indicates that they will do this. Two common sources of motor failures are the bearings and insulation, the chief enemy to the latter being lubricant thrown from the ordinary type bearings. The cost of bearings is of small account if they increase the reliability of the motor and reduce maintenance charge. It is not alone what it costs to repair the machine, but the other losses incident to motor failures, which may be many times the actual costs of repairs. If the use of ball and roller bearings will eliminate a large part of this loss, then they are in an unquestionable economic position.

The Boiler-Room Bonus

A FEW years ago the boiler-room bonus was a popular subject. We hear less about it now, notwithstanding there are just as many incentives—perhaps more than ever—to make it worth while. In fact, the higher fuel prices make some form of bonus more urgent than ever, both for the man who buys the fuel and the man who is expected to save it.

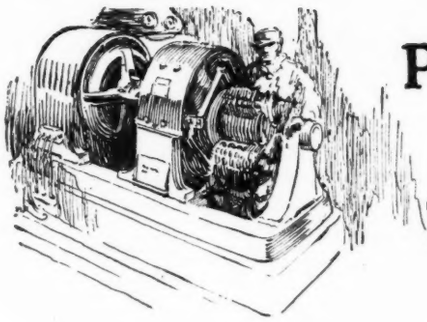
There is a general impression that the bonus is justified only in the big plant. Obviously, this is not true, since the important thing is not the total fuel used, but the percentage that is saved. The fuel saved, moreover, usually will be of greater importance to the small plant, but on the other hand, the bigger the plant the more likely it is to have the personnel, the equipment, the records, the will and the stamina to develop and maintain an equitable and practical form of bonus.

Two conditions have caused the boiler-room bonus to lag and often fail. One is that so many forms of profit sharing, in seeking simplicity, fail to include the fundamental factors involved; the other is that the inducement for the men to save is insufficiently attractive. The former is more difficult to settle than the latter, but neither is insurmountable. To work, a bonus must be complete enough to safeguard the man who pays for the fuel and the man who saves it, yet not so complex as to be impractical. Preferably, it should be such that the men themselves may figure out what they save and what they have coming to them.

Changing shifts of men; the inherent load characteristic of each shift; the numerous conditions over which the men have no control, such as banked fires and forced rates of evaporation, mitigate against the success of bonus systems based upon the over-all input of fuel and output of kilowatt-hours.

Many bonus systems have been based solely upon CO_2 and stack temperatures; but these do not suffice, for CO_2 is only a means to an end—evaporation. In fact, high carbon dioxide can be obtained by careful firing with low rates of evaporation by one fireman, while the men next to him may have lower CO_2 while they are doing most of the work. In this case the man who earns the bonus is the man who shirks. He produces CO_2, while the other fellows do the evaporating. That is why every boiler-room bonus, to be equitable and workable, must contain fuel consumed and water evaporated as the two major factors.

Power is always anxious to hear of systems that are in use, or of those that have been tried and discarded, and the reasons why. The boiler-room bonus is a move in the right direction, and the time has never been more favorable than the present. Fundamentally, the idea is sound because it is only when the men who strive to save fuel participate in that saving that the biggest saving will accrue.



Practical Ideas *from* Practical Men

Forgot the Soot—Blamed the Stoker

The following is a report received from a service engineer of a prominent stoker manufacturer:

Upon receipt of your letter advising me of a complaint from ————————, I called at the power plant and found the fireman having considerable trouble in keeping up steam. I checked up the draft and the uptake temperature, found the temperature 650 deg. F. I immediately instructed the fireman to blow the flues, and as soon as this was completed the steam pressure went up from 65 to 100 lb. in fifteen minutes; the uptake temperature dropped to 510 deg.

The flue blowing was left to the night fireman and the engineer never checked it. They blamed the trouble on the stoker. Please note that I came three hundred miles to instruct somebody to blow flues.

————————,
Service Engineer.

So much has been said on the subject of clean boilers, it is hard to understand why some engineers overlook the soot; but they still do it, and they blame the final results on the boiler and stoker manufacturer and kick vigorously when they get a bill for service.

Chicago, Ill. F. A. MORELAND.

High- and Low-Speed Brine Agitators

In most ice plants the brine agitation is looked upon as a necessary evil and little attention is paid to it. The brine should be circulated fast enough to keep it in motion in all parts of the tank, but not so fast that it will cause the cans near the agitators to list and make uneven ice.

The best method of obtaining good agitation is by using slow-speed agitators, and if necessary, as in large tanks, two or more propellers should be placed in parallel. High-speed agitators may be made satisfactory if the tanks are properly baffled near the propellers, but only seldom are they found arranged satisfactorily.

It is almost impossible to keep the packing glands from leaking brine with high-speed horizontal agitators, and if the brine leaks into the oil well, in a little while the shaft will not receive proper lubrication and will heat. Vertical agitators, unless driven by vertical electric motors, have a great disadvantage in requiring gears, etc., submerged in the brine, and as a rule cause more grief than the horizontal ones.

Uneven ice is especially hard to store. Not only is it impossible to store as much in the same space as could be done if it was even, but in handling the sharp edge is almost invariably broken off and a great deal lost. Not long ago I visited a new plant of modern design, in both building and machinery, and was surprised to find the tanks agitated by high-speed machines. These agitators were of the vertical-motor direct-connected type running at 1,160 r.p.m. The cans near the propellers were so badly listed that there was nearly a foot difference in the top edges of the ice. The engineer said he was having trouble in storing the ice and had to hire extra help to take care of the scrap.

I have found that the slow-speed horizontal agitators equipped with brass shafts are the most satisfactory and give the least trouble. The experiences of other engineers may not have been the same as mine, so a difference of opinion will be cheerfully recognized.

Riverbank, Calif. M. E. BELL.

Cleaning the Outside of Condenser Tubes

The usual method of cleaning the outside of condenser tubes is to boil off the sediment by means of hot water with caustic soda. Sometimes, however, sediment or scale is formed on the outside which cannot be removed by this means on account of being too hard or insoluble. In some instances it has been found necessary to remove condenser tubes and clean the outside scale by mechanical means. In one instance a large surface condenser was being dismantled, as it was found necessary to remove a comparatively hard insoluble scale from the tubes. Washing the tubes was considered inadequate Cleaning was effected by rubbing with a rag impregnated with sand and kerosene. This gave poor results, as the night gang of four or five men could turn out only about 200 or 300 tubes per night. It was found that this rate of cleaning would put back the job of erection by one or two weeks.

In order to speed up the cleaning of the tubes, the use of a buffing wheel was investigated. The ordinary method of cleaning with a buffing wheel is to place the tube parallel to the shaft and rotate the tube while it is passed across the face of the buffer. This was easily seen to be little improvement on the original method.

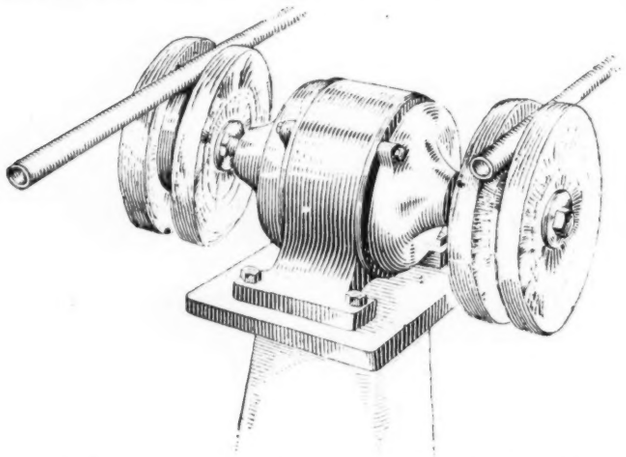
A quick and satisfactory solution was found by using a buffer as shown in the illustration. Two 10-in. diameter buffing wheels were mounted with a smaller wheel of 6 or 8 in. diameter in between them. The entire length of tube was then passed perpendicular to the shaft without turning the tube over. One pass cleaned the bottom and two sides effectively. The flexibility and wiping action of the wheels actually cleaned somewhat more than both sides, comprising a little of the top. The tube was now turned 180 deg., or in other words given one-half turn, and drawn back in the reverse direction. This completed the cleaning of the bottom and the sides.

One tube could be cleaned in from 15 to 50 seconds, depending on the condition of the tube, as well as the morale of the operating force By using two buffers, one on each side, as shown, and two crews of men, the

work was finished in about one-fourth of the time that would otherwise have been required.

In handling condenser tubes 20 ft. in length, it is necessary to place tables or trestles so that bending of the tubes will be avoided. The illustration does not show the tables for handling the tubes. These can be rigged up to suit the requirements of the situation.

It is very important that the buffer be run at the proper speed and with sufficient power, and that a good



Buffer arranged to clean condenser tubes quickly

supply of "tripoli," or abrasive brick, shall be kept on hand for applying to the wheel. This makes the buffing wheel cut. The wheels themselves last from one to three days, depending on the service. A 5-hp. motor or larger is recommended.

S. NAJINSKY.

Springdale, Pa.

Practical Suggestions in the Preparation of a New Eccentric Strap

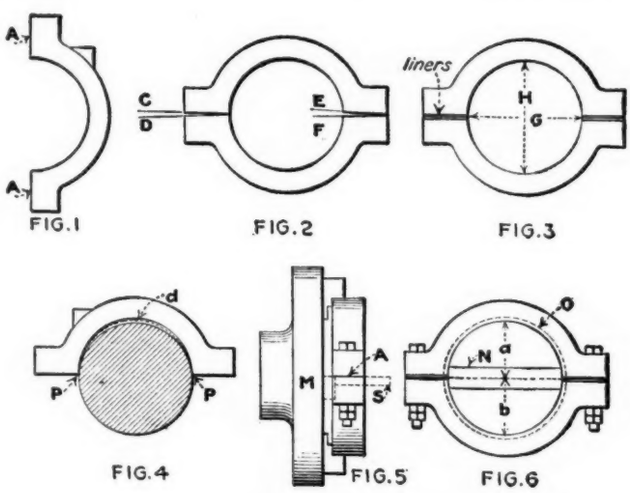
In the preparation of a new eccentric strap there are several essential points which are imperative if we mean to produce good work. If these points are neglected, the strap may be distorted and out of truth to such an extent that even the skill of the mechanic will fail to make a successful job.

Taking the halves of the strap, the first operation will consist of machining the joint faces *A* square with the rough sides of the strap, Fig. 1. The mechanic should then bed the machined faces down to a surface plate. This is an important point, as it is most essential that, when coupling the halves, they should come snug together without the slightest tendency to spring.

To illustrate this more clearly, suppose that the two halves of the strap were put together as they left the machine without the joint faces being bedded to a surface plate; under such conditions it may be possible, owing to the faulty machining, that the joint faces come together as shown by the lines *C*, *D* and *E*, *F* in Fig. 2, indicating the amount to which the machining is faulty. Suppose, then, we bolt the two halves together and bore the strap. So long as the two halves are held together by the bolts, the bore will be true, yet as soon as the bolts are released, the bore will become distorted and the diameters *G* and *H*, Fig. 3, will be different. This will seriously impair the fit of the strap on the eccentric sheave.

Having bedded down the faces of the eccentric strap to the surface plate, they are ready for bolting together. It is a good plan to put a sheet-tin liner between the joint faces before bolting, as shown in Fig. 3. The reason for this is that if the halves are bolted together without the liners and the strap is bored to the diameter of the eccentric sheave, it will be found that when the bolts have been slackened and the strap diameter measured, *G* will be smaller than *H*. This is due to the tension of the casting. The strap will therefore not fit on the sheave, but will bind at the points *PP*, Fig. 4. To obviate this, liners should be put between the joint faces of the two halves of the strap.

The strap is now ready for boring and is set so that the line *A* of the joint faces is true to the square *S* tried from the face of the chuck *M*, as shown by dotted line, Fig. 5. This insures the side of the strap being machined true and at a right angle to the joint faces; the strap is then turned over to face the other side. Some machinists also bore the strap at the second setting, but owing to the pressure of the jaws of the chuck tending to spring the work out of its natural shape, it is better to make a separate operation of the boring. Before mounting the strap for boring, it is a good plan to put a center piece of iron *N* across the rough bore of the eccentric strap, Fig. 6; then with a straight-edge set to coincide with the line of the joint faces, project the line across the bore on the center piece *N*. Next find the center between the two bolts that hold the strap together and mark this on the center piece, and from this point where the marking cuts the line of the joint faces describe a circle *O* on the side of the strap and center pop it. This will enable the mechanic to set the strap true for boring and insure that the radii *a* and *b* will be equal. If this were not so, and *a* and *b* were not equal, the one-half of the strap would not go on the



Figs. 1 to 6—Progressive steps in machining eccentric strap

eccentric sheave; it would be too small at the points *PP*, as shown at Fig. 4, the dotted line *d* representing the true bore.

The eccentric strap is next mounted for boring, holding it down to the face by plate and bolts to avoid distortion and adjusting the position of the strap until the circle *O* described on the face of the strap runs true to a pointer fixed in the tool post.

The strap is then bored to a diameter equal to the diameter of the eccentric sheave plus the thickness of

the tin liner that was placed between the joint faces of the strap. Thus when the tin liners are removed the bore will be equal to the diameter of the eccentric sheave and the points *PP* will be free to allow the strap to bed down on the crown. THOMAS W. AIREY.

Gainsborough, England.

An Emergency Refrigerating-Plant Repair

Some years ago, while in a Southern town installing a small refrigerating plant I was asked by the superintendent of the local ice cream factory to go over and help him solve some trouble in his refrigerating plant.

As there happened to be a hot spell in the early summer, the company was doing a rushing business, and was running two ten-ton machines on high suction pressure and one two-ton machine on the sharp freezers.

The condensers consisted of two stands of double-pipe construction, each having 12 pipes 20 ft. long. The

Using pipe and hose in place of defective coil

rated capacity of these stands would probably total about 25 tons with 60-deg. condenser water. The water was piped from the condenser to a tank on the roof of the building, from which it was piped to the various parts of the building around the plant.

The trouble started when some of the help complained of ammonia in the water. The superintendent was at a loss as to how to locate the cause of the trouble.

I took along some litmus paper, and a few tests convinced me that there was considerable ammonia in the water. The double-pipe condenser was at once suspected, the connections at the water outlet at the top of each stand were opened and each stand tested separately, at the same time running the water through them very slowly by reducing the pump speed.

One of the stands showed a bad leak. So, after putting the other stand back in service, we removed a few of the return bends, starting at the top and working down. The water that came out of the end of the water pipe was tested as each bend was disconnected until four of the bends had been disconnected. When the fifth bend was removed and the test was made, the water showed traces of ammonia.

By plugging one end of the pipe above the last one that tested clean and placing a sulphur stick at the other end, there was no difficulty in determining that the leak was in this pipe. In fact this was not necessary, for the leak was so bad that one could not stand near the end of the pipe after the other end was plugged up. Evidently, the water pipe had split, as the condenser was only a year old and could not have pitted enough to cause the leak in that time.

Like many other installations the condenser had been installed in a place where it was impossible to remove the water pipes without taking the stand off the foundation and swinging it to one side. This is a point that many men responsible for the layout of small plants never considered.

The company was rushed with business and a shut-down of the refrigerating plant or rather a part of it, would mean a serious loss, as the refrigerating machines had been crowded to their maximum capacity. The owners and the superintendent were willing to go to any expense, even to the price of a whole new stand, if the plant could only be kept in operation. The cost, within reasonable limits, was a minor consideration.

The solution of the problem, however, was quite simple, and the total cost was the price of about three feet of new hose. The defective coil was removed, which left two of the return bends unconnected. A piece of pipe about sixteen feet long was screwed into one of the bends, extending along the side of the condenser. Another piece about two feet long, was screwed into the second bend and the space between the two pipes connected together with the piece of new hose, making a flexible connection between the two pipes. The outer, or ammonia, pipe was put back into place and the outer ends of the fittings capped to prevent ammonia leaking. This completed the job, which took only a short time, and the condenser was put back in service. The only drawback to the makeshift job was the loss of capacity of one pipe out of a total of 24, which made no material difference.

The condenser was operated in this manner for the whole summer, until the entire load could be carried on one stand, when a new pipe was inserted. The old one had been split for three inches. C. M. LAMBERT.

Chicago, Ill.

Starts a Fire with Concrete

In my laboratory boiler room the attendant had, on instruction, pulled the fire from the superheater element just before the luncheon hour, the ashes being collected in a tidy heap on the concrete base in front of the furnace. This same procedure has been followed on numberless previous occasions with regard to both the superheater and the boiler furnaces. During lunch no one was present in the boiler room, but just ten minutes after the fires were pulled I passed through the room and found fires blazing merrily in all corners of the room. With assistance all fires were ultimately subdued, any one of which, uncontrolled, might have caused heavy damage.

On looking round for the cause of the havoc, it was noticed with surprise that the whole of the collected heap of hot furnace ash had disappeared and on the spot where they had been dumped an egg-shaped section of concrete, about eighteen inches by twelve, had been blown out. Small portions of concrete were subsequently found in various parts of the room.

The cause of the explosion was the imprisonment of some water in the cement, the consequent formation of steam supplying the force required to rupture the layer of concrete and so generously distribute the hot ashes over the room. The depth of concrete lifted varied from two to three inches and comprised the finished surface usually laid over the coarser concrete of a floor foundation.

Had this explosion occurred during the night with no immediate observers, the fire which must have inevitably followed would have wiped out all trace of the original cause. Any committee of inquiry subsequently appointed would have been left guessing.

WILLIAM J. WALKER,

Dundee, Scotland. University College.

Comments from Readers

Indexing and Filing Articles

Some time ago the editor in his Foreword invited the readers of *Power* to discuss methods of indexing and filing articles.

A method that I apply is to use an ordinary folder such as one can purchase in any stationery store for filing the most important articles, particularly those that I am most interested in.

The articles are arranged in a file alphabetically as follows: Air, Arches, Ash-Handling Machinery, Baffles, Bearings, Belting, Blowers, Boilers, Burners, and so on through the alphabet.

The method of indexing that I have found particularly valuable and that I believe will interest other readers is to letter the subject close to the upper edge of the folder in small distinct lettering. The reason for this is that by placing the lettering close to the upper edge it is often visible without touching the files with one's hands at all. Where the word is written large and down on the line provided by the manufacturer of the folder it is generally necessary to thumb the folder in looking for the name. This can be avoided by getting the lettering within the angle of vision. I find it to be a great time saver.

Elizabeth, N. J. L. W. LOWERRE.

A Predecessor of the Benson System

In the May 22 and May 29, 1923, issues of *Power* were published two articles on the Benson super-pressure system of power generation. Ten years before Benson obtained and published the results of his study and experience, I obtained the same favorable results relative to the economy of the steam turbine for the critical pressure from my own personal calculations, and published them in the *Zeitschrift des Oesterreichischen Ingenieur und Architekten-Vereines* (Journal of the Austrian Engineering and Architectural Society), No. 42, issued in October, 1913.

DR. JAROSLAV HAVLICEK.

Moravska Ostrava, Czechoslovakia.

[With this letter Doctor Havlicek sent a copy of the publication mentioned. This contained a four-page article dealing with the possibility of increasing thermal efficiencies by raising pressures to the critical point and higher, and by the use of other materials such as mercury, sulphur, etc. Temperature-entropy diagrams extending well above the critical point were drawn for water and other materials. One line in particular showed the generation of steam at the critical point, superheating up to 800 deg. F. and adiabatic expansion down to a vacuum. The following paragraphs taken from the article may serve to indicate the author's line of thought and some of his main conclusions.—Editor.]

The increase of steam pressure up to 1,500 lb. gives a considerable increase in the effective temperature range, while operation with a pressure of 3,000 lb. and a temperature of 800 deg. F. would give an improvement of at least 32 per cent over ordinary conditions.

The construction of a turbine for 3,000 lb. offers no difficulty. The fall from 3,000 lb. to 30 lb. (absolute) can be made in two velocity stages, as from 3,000 to 300 and 300 to 30. The greater part of the turbine remains unchanged.

It is true that the pure adiabatic runs into the heavily saturated region, but the reheating effect of the turbine losses throws the expansion line farther to the right, so that the steam in the later stages is less saturated than would appear from the diagram. However, with this kind of a turbine it is necessary to count on a high degree of saturation, and for the greatest simplicity and economy removal of the condensed water from the later stages must be arranged.

I have prepared temperature entropy diagrams for many other materials. To get better results than are possible with steam or air, it is necessary that a material be employed which (like mercury) is in a saturated condition throughout the practically possible temperature range. In this saturated region the Rankine cycle is very close to the Carnot.

The article may be summarized as follows:

1. Through the employment of steam of about 3,000 lb. and 800 deg. F. the thermal efficiency of a steam turbine can be increased to about 43 per cent. Compared with present operating conditions this means a coal saving of about 32 per cent.

2. Further increase of the thermal efficiency is not practically possible with present type of equipment.

3. One apparently generally valid law of the heat theory is that the heat properties of all materials follow the same universal laws through all states of pressure and temperature. That is, the temperature-entropy diagram for all materials is the same except that certain of the scales must be adjusted for the different materials.

Why Worry the Engineer with Useless Examination Questions?

In the Dec. 25, 1923, issue, page 1025, are a number of questions asked of an applicant for an engineer's license. It is my opinion that a great many of these, for an operating engineer's license, are absolutely useless, such as Nos. 6, 7, 8, 9, 27, 28, 35 and 36.

An operating engineer is never employed to design boilers or pass on the proper working pressure of boilers of whatever design. This is done by the Boiler Insurance Co. or the State Boiler Inspectors or both. If this commission had questioned the engineer on heat, heat transfer, arch work, brick settings, instruments for the proper check of plant operation, the effect of dirty boiler tubes on economy, water purification, combustion of coal and temperature of feed water, it would have been much better.

Naturally, the commission would state that the questions on boiler construction and safe working pressures are to protect life and that they are not interested in economy, but as already stated, the engineer has no authority to pass on the proper working pressure of any boiler. If the commission would keep the questions within the scope of the operating engineer's duty, it would be reasonable, and a plant run on an economy basis is sure to be much safer for the operators than a plant operated under a chief who is trying to design a new type of boiler.

WALTER DALTON,
Philadelphia, Pa. Consulting Engineer.

Why Not Give the Engineer Credit?

I have read with much interest your comments upon the address by the retiring president of the A.S.M.E. in your Dec. 11, 1923 issue, and particularly the following extract:

But the engineer has been so intent upon devising means for production, upon improving the quality of product and of managing the men and tools of production to secure the maximum results, that he has failed to develop his ability and to establish his position in the other leading factors of life, to which he is entitled by virtue of his part in production and the resulting welfare.

In this connection I would call your attention to a timely editorial published in the *Journal and Transactions of the Society of Engineers* (British), November, 1911, which discloses the psychological reflex of the engineer's mental make-up. What is true in Great Britain on this point is true here, and this editorial could have been written today and still hold true. The event prompting the editorial was the following:

"Senor Garica Prieto, Spanish minister of Public Works, yesterday inaugurated at Canfranc the new tunnel through the Pyrenees. There was a great crowd of spectators. M. Simyan, French Under-Secretary of State for Posts and Telegraphs, represented the French Government. The Archbishop of Saragossa celebrated Mass at the entrance of the tunnel. The railway company gave a banquet, at which covers were laid for 110 guests. Cordial toasts were exchanged. The engineers then blasted away the rocks remaining at the entrance of the tunnel."

Perhaps it might be contended that in the above the names of all concerned could not be compressed into a necessarily limited space, but we have a cutting from a daily newspaper of Oct. 18, 1911, describing the opening of a transport bridge by one of the Royal Family, where in the course of a 700-word report the word "engineer" occurs only once, and then quite casually: ". . . the invited guests included members of both houses of parliament, military officers, *engineers* and others."

The editorial follows:

Most of us read newspapers at more or less regular intervals. If we do not study their pages with consistent thoroughness, we at least give attention to those subjects which most strongly appeal to us—art, literature, politics, sport, or any of the thousand and one things that make up our sum total of sympathy with our fellow men—while now and again we encounter something of professional interest, and here at times a disappointment awaits us.

For instance, we may read a report of the inauguration of some great engineering work; a stupendous achievement which has required for its conception the highest type of engineering genius, and for its successful accomplishment has levied toll upon the utmost resources of modern engineering science. The history of the scheme is unfolded; we are told how the authorities deliberated at great length and sent investigatory committees far afield to examine existing works, of the public-spirited assistance given by landowners and men of substance in the neighborhood, of the numbers of men employed day and night for so many months or years, what immense sums of money were expended and how great will be the benefits and recompense that will accrue to the community from all these labors. The stately circumstances of the inauguration are related in detail; we learn the names of the notabilities assembled to receive the great personage who performs the opening ceremony, of his reception with military honors and civic pomp, and how, after a congratulatory speech, the pressing of an electric button and a valedictory shower of knighthoods, he passed processionally through the crowded streets amid scenes of popular rejoicing.

But we must have scanned the page too hurriedly! There seems to be something still lacking, something we have missed through inattention or haste, it may be. The pæan of praise has so deafened us that we have not heard the note for which we were listening, a gentle note of restrained wonder at the ingenious mind to which the completed work owes its perfection, a quiet harmony of deserved admiration for the labor and thought expended by the designer of so great an enterprise.

Let us turn back and read at leisure the phrase which we feel sure must be there, although it has passed unnoticed at the first perusal. "The city fathers had exhibited praiseworthy foresight . . ." Good men and true, no doubt, but we seek another. Try once more: "His Royal Highness said that the work would prove of incalcuable value and would stand unrivaled as a monument of engineering genius . . . The contract was admirably carried out by . . . "

Gentlemen of the Press, will you please tell us, who was the engineer?

It is a custom of some of the principal London dailies to state prominently in their reports of legal proceedings, the names of the barristers and solicitors engaged upon each case. Would it not be fair to treat engineers at least equally well?

Substituting "President," "Governor," "Mayor," etc., for "His Royal Highness," etc., we can apply this editorial to any public event of a similar nature in this country.

Wherein the editor's footnote states that engineers should receive the same recognition from the press accorded to barristers and solicitors, the comments on the question of licensing engineers by Mr. Harrington apply. The barrister, like the doctor, is licensed to practice, and that in itself compels recognition. That is the whole question in a nutshell.

Engineers should be licensed by all means. Their profession is as important and as dignified, although in a different direction, as that of the medical doctor or the attorney at law. In most European countries laws to that effect exist. In Italy, for instance, engineer diplomas are issued only by the government universities and are legal tender to practice the profession. Private universities, corporate or not, do not exist simply for the reason that if they did exist, their diplomas would not be legal. A.C.E., M.E., E.E. or other engineering diploma is a professional legal recognition as well as a social one of one's status.

In Italy the application for a building permit must be signed by a civil engineer or an architect who must be employed by the owners, and this act makes the engineer automatically responsible for any accident during or after construction due to faulty design, inferior materials or workmanship or faulty supervision. Only in the building of machinery it is not necessary to obtain a permit, although a man without a diploma cannot practice the profession of mechanical, mining, electrical, industrial or any other recognized classification of engineering.

Some similar arrangement could be worked out in this country, except that the scheme must be made to fit the existing educational system. Private and corporate universities are national institutions in this country and must be recognized. Legal recognition of them, or such of them as conduct courses of unquestionable standards, making their diplomas legal tender to be recognized by all the states, together with uniform state legislation whereby a mild form of examination would entitle the already legally graduated engineer to practice his profession in one or all the states, would go a long way toward making the profession a closed and more responsible one.

J. BARRAJA-FRANENFELDER,
Consulting Diesel Engineer,
Sun Shipbuilding & Dry Dock Co.
Chester, Pa.

QUESTIONS AND ANSWERS

Conducted by Franklin VanWinkle

Freezing Point Lowered by Increase of Pressure

Will water in a feed-water supply pipe freeze as quickly when kept under high pressure as when under pressure of the atmosphere? *C. W. M.*

The freezing point of quiet water is slightly lowered by increasing the pressure. For every additional atmosphere of pressure, the freezing point is lowered by 0.0075 deg. C., which is equivalent to about 0.001 of 1 deg. F. for each additional pound pressure per square inch.

Temperature of Water for Hydrostatic Testing

Should cold or hot water be used in making a hydrostatic test of a boiler? *D. H. W.*

Hot water would be better from having the temperature conditions more nearly the same as when the boiler is in regular use. However, where the intended working pressure is determined from competent inspection and computations, with application of the proper factor of safety, there is no reason to believe that the usual hydrostatic test pressure 50 per cent greater than the proposed working pressure gradually applied by a hand test pump would be any more injurious from using cold water than from use of warm water.

Dutch-Oven Furnace Impractical for Small Return-Tubular Boiler

We have a 48-in. diameter by 12-ft. long return-tubular boiler with furnace 48x42 in. The boiler is set 24 in. above the grates and 6 in. above the bridge wall, with the floor of the combustion chamber sloped from nearly the top of the bridge wall to the rear connection of the setting. For burning soft coal, would there not be an advantage to use a Dutch-oven setting, stoked from the top and have the present furnace filled to the top of the present bridge wall? *J. D.*

The cost and large proportion of furnace heat lost by a Dutch-oven furnace of suitable proportions would not pay for a boiler of the size stated under ordinary conditions of operation and forcing, unless it may be thought worth while to incur the expense for better elimination of smoke. The slope of the floor of the combustion chamber behind the bridge wall in the present setting is of no benefit, except to facilitate cleaning, and of no better effect than having the space filled with soot and ashes to the same height. More complete combustion would be obtained with the present setting by having the combustion-chamber floor level with the ashpit floor to secure better mixing of the gases from the furnace before they are brought into contact with the heating surfaces of the boiler.

Omission of Beaded Tube-Ends in Water-Tube Boilers

Why are the tube ends of water-tube boilers only flared and not beaded? *W. H. D.*

Beading over the ends of tubes in fire-tube boilers is principally beneficial as a safeguard against the tube-ends becoming burned, as the durability of beaded tubes in resisting the action of the fire is much greater than when they are only flared. The tube ends of water-tube boilers are not thus exposed, and the beading is preferably omitted, since it has a tendency to split and otherwise injure the texture of the material, and unless the flaring and subsequent beading are skillfully performed on good tube material, the operation has a tendency to disturb the tightness of the joint made by expanding the tube in the tube sheet, and as the tube material becomes more or less granular under the operation of beading its holding power as a stay is seriously impaired. Numerous experiments on the holding power of boiler tubes expanded into tube sheets have demonstrated that the operation of beading materially lowers the initial resistance. When a tube has become started from its original seat, the fit may be no longer continuous, and when the tube material has become distorted or is under irregular stresses from beading, a small movement is the preliminary of a leak.

Live Steam for Heating Feed Water

In the operation of three 72-in. h.r.t. boilers for supplying steam to pumps, we use the exhaust from the pumps to heat the feed water in a closed heater in which the temperature is raised to about 120 deg. F. Would there be any saving of coal or steam to inject live steam into the exhaust pipe of the heater for raising the temperature of the feed water? *W. R. L.*

The use of live steam drawn from the boilers for heating feed water can be of no possible advantage in saving of heat, as there can be no saving by taking heat away from the boiler and putting it back again. On the other hand, there would be disadvantage from losses of heat sustained by radiation from the steam piping and connections, and when added to the exhaust, live steam would be likely to increase back pressure on the pumps and part of the heat would be discharged along with the exhaust. The only advantage in using live steam for heating feed water would be in the treatment of the water for removal of scale-forming impurities, and the benefit of feeding hot water to prevent irregular expansion and contraction of the boiler from local variations in temperature of the boiler water.

Control of Engine Speed

What controls the speed of a Corliss engine, the valves or the governor? *G. E. R.*

The speed depends on the operation of the valves, but their manner of operation for admission of the appropriate amount of steam to bring the speed to normal or hold it there depends on the regulation of the valves that is exercised by the governor in virtue of its position. When the speed falls below normal, the governor brings about the operation of the valves for the admission of more steam by a later point of cutoff, and when the speed is above normal it causes earlier cutoff, which tends to reduce the speed of the engine. The governor is thus a monitor and the primary mechanism that controls the speed, while the valves operate in obedience to the governor.

Heat Balance

What is meant by heat balance of a boiler plant? *R. G. D.*

A heat balance of a boiler plant is a tabulated statement or balance sheet, test data and analyses, to exhibit the heat utilized in the generation of steam and the various heat losses per pound of dry fuel based on actual evaporation test data and analyses balanced against the total heat of theoretically perfect combustion of one pound of dry fuel based on analyses of the fuel. For greater convenience of interpretation the various items usually are carried out in percentages, as in the following example, in which the heat per pound of dry fuel was 14,460 B.t.u.

	B.t.u.	Per Cent
Heat absorbed by boiler	9,917	68.58
Loss due to moisture in the coal	51	0.35
Loss due to moisture formed in burning H in coal	472	3.26
Loss due to heat carried away in dry chimney gases	2,367	16.37
Loss due to incomplete combustion of carbon	257	1.78
Loss due to unconsumed carbon in the ash	687	4.75
Loss due to radiation and unaccounted losses	709	4.91
Total	14,460	100.00

Increase of Power from Operating Condensing

How is it explained that by operating an engine condensing under 26 in. vacuum, in place of non-condensing with 2 lb. back pressure, the power developed by the same amount of steam would be increased, or the same power would be developed with less steam supplied to the engine? *J. C.*

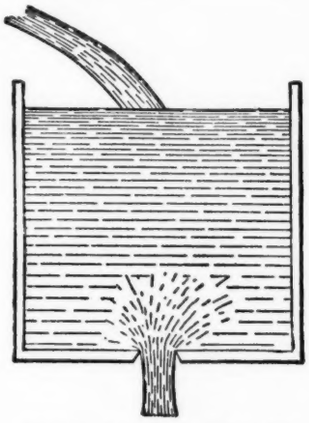
The power developed by the steam is directly in proportion to the mean effective pressure acting on the piston. If the average pressure acting on the piston during a forward or power stroke is 50 lb. per sq.in. gage, or pressure measured above the pressure of the atmosphere, that would be equivalent to 50 + 14.7 = 64.7 lb. per sq.in. absolute, or pressure above a perfect vacuum. If the average back pressure is 2 lb. gage, or 2 + 14.7 = 16.7 per sq.in. absolute, or pressure above a perfect vacuum, then the mean effective pressure would be 64.7 lb. per sq.in. absolute less 16.7 lb. per sq.in. absolute, or 50 lb. gage less 2 lb. gage, equal to 48 lb. per sq.in. mean effective pressure. If the engine operates against an average back pressure of 26 in. vacuum—that is to say, 26 in. mercury-column pressure less than the pressure of the atmosphere—then as 1 in. mercury-column pressure is equal to 0.491 lb. per sq.in., 26 in. would be 26 × 0.491 = 12.76 lb. per sq.in.; and as the pressure of the atmosphere is 14.7 lb. per sq.in. above a perfect vacuum, it follows that "26 in. vacuum" would be 14.7 — 12.76 = 1.94 lb. per sq.in. absolute, or pressure above a perfect vacuum. Hence, when the average forward pressure acting on the piston is 50 lb. gage or 50 + 14.7 = 64.7 lb. absolute, and the average back pressure is 26 in. vacuum, or 1.94 lb. per sq.in. absolute, the mean effective pressure would be (50 + 4.7) — (14.7 — 12.76) = 64.7 — 1.94 = 62.76 lb. per sq.in. m.e.p.

However, it must be borne in mind that the average back pressure on the cylinder never is as low as the pressure shown by the gage on the condenser. Part of the back pressure which opposed the piston during the return stroke is due to the exhaust being held back in its flow to the condenser by friction of the exhaust passages; and usually, there also is back pressure due to compression of the exhaust from closure of the exhaust valve before the piston reaches the end of the return stroke. Hence the average back pressure during the return stroke, and consequently the m.e.p., cannot be known from the condenser pressure, but must be determined from actual or hypothetical indicator diagrams.

Measuring Cooling Water

What is the best method of measuring the cooling water used in surface-condenser tests of large steam engines and turbines? *R. C. T.*

Notched weir measurements usually are the most convenient, but any mistake in determining the head will result in greater percentage of error than from use of a submerged orifice. Where great accuracy is desired with ordinary facilities for construction of measuring apparatus, a vertical-sided tank with a sharp-edged orifice in the bottom, as illustrated, is preferable, especially where a variable flow is to be measured. The discharge is readily calibrated for different heads above the center of the aperture and having the aperture small enough, the magnitude of variations of the head obtained with different rates of discharge is limited only by the depth of tank employed.



Vertical sided tank with submerged orifice

[Correspondents sending us inquiries, should sign their communications with full names and post office addresses. This is necessary to guarantee the good faith of the communications and for the inquiries to receive attention.—Editor.]

Here and There in the Power Plant

Sidelights on things generally used but less generally understood

Effect of Increased Pressure on Steam Consumption

IF THE average man were asked whether increased steam pressure would mean that each pound (weight) of steam would develop more power in an engine, he would doubtless answer yes. The answer would be correct. At the same time he would generally have a wrong idea as to the reason for this result, reasoning about as follows:

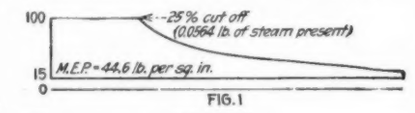


FIG. 1

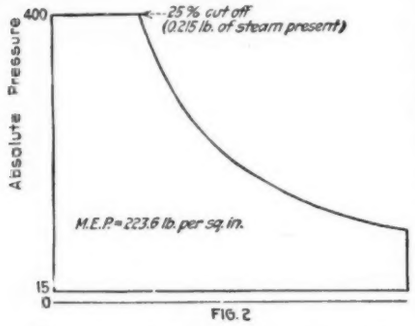


FIG. 2

Figs. 1 and 2—Gain at constant cutoff

"Steam generates power by pushing on a piston. The harder it pushes the more the power. High-pressure steam pushes harder than low-pressure steam; hence it will generate more power."

This seeming demonstration does indicate that a given-sized engine will develop more power with high-pressure steam It does not, however, show anything about the relative power developed by equal weights of high-pressure and low-pressure steam.

With the same size engine, with the same cutoff and speed, the power will be proportional to the mean effective pressure (or the average heights of the indicator cards if the same indicator spring is used in both cases). The diagrams shown in Figs. 1, 2, 3 and 4 are theoretical indicator cards considerably simplified to make comparison easy. They are from an imaginary engine operating without clearance volume, without compression, without friction, with no throttling losses and with expansion along a true hyperbola. While these assumptions differ considerably from practical conditions, they will serve to give a general idea of the effect of increased pressure.

Figs. 1 and 2 clearly show that higher pressure means more power *for the same engine*, with the same cutout and same back pressure. The power *per pound of steam* is a different matter, since the high-pressure steam is more dense and hence a greater weight of it is present at cutoff, provided the cutoff is the same in both cases. It is an easy matter to figure the relative weight of steam consumed by the two engines. Assuming 1 cu.ft. cylinder volume, the weight consumed per stroke will be the weight of one cubic foot of steam at the given pressure multiplied by the fraction of stroke at cutoff. The steam tables give the weight per cubic foot as 0.2258 lb. at 100 lb. pressure and 0.86 lb. at 400 lb. pressure. The final computed weights per stroke are marked on the cards. These figures show that the engine operating with 400 lb. pressure consumes 3.8 times as much steam as that operating at 100 lb. In other words, for a constant cutoff the total steam consumption goes up almost in proportion to the absolute steam pressure.

Now if the engine will develop more than 3.8 times as much *power* with the higher pressure it is evident that the increase in pressure will cause a reduction in the consumption of steam per horsepower-hour. Measuring the areas of the indicator cards or figuring them from the formula for the area under a hyperbola, the mean effective pressure is found to be 44.6 lb. in the first case and 223.6 in the second. The power being proportional to the mean effective pressure, the high-pressure engine will develop 5 times as much power with 3.8 times as much steam, thus developing 32 per cent more power per pound of steam.

It should be particularly noted that this is not a general proof of the advantage of high pressures, but merely the proof for one particular arbitrary set of assumptions. For one thing, it has been assumed that the cutoff is the same in both cases. This is not necessarily a reasonable condition.

Where the steam is used in a turbine, the expansion is complete, as shown in Figs. 3 and 4. While in the turbine there is no actual cutoff as in a reciprocating engine, the effect obtained is the same, and this equivalent cutoff automatically adjusts itself for any initial pressure so that the expansion line will run completely down to the back pressure. As a result, for a given exhaust pressure the cutoff automatically becomes shorter and shorter as the initial pressure is increased.

Working it out on the basis of the assumptions already given, the cutoff is found to come at 15 per cent for 100 lb. pressure and 3.75 per cent for 400 lb. pressure. With complete expansion the gain by increasing the pressure is even more than with a fixed cutoff. For example, figuring by the method already explained, Fig. 4 shows 83 per cent more power per pound of steam than Fig. 3.

The exact values of these figures should not be taken too seriously, as so many assumptions have been made as to invalidate them for any close application to practical cases. At the same time they do show such a decided gain for high pressures that some of this gain might be expected to be realized in practice. Such is in fact the case, the steam consumption per unit of output steadily decreasing as the pressure goes up. To compute the effects of such factors as cylinder condensation, clearance volume, leakage, etc., is far beyond the scope of the present article, but it may be noted that cylinder condensation, being more serious with high pressure and early

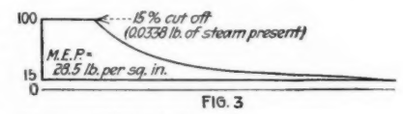


FIG. 3

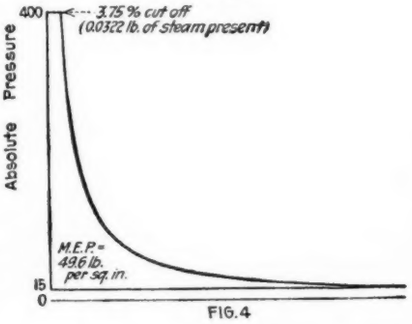


FIG. 4

Figs. 3 and 4—Gain with complete expansion

cutoff, operates to reduce the gain of the high pressure. This of course applies only to reciprocating engines and not to turbines.

The ordinary method of figuring the power available from expanding steam is entirely different from that just shown and requires the use of an entropy diagram. While the entropy diagram is much more convenient and reliable for actual computations, the method here used gives a simpler mental picture.

How a Textile Finishing Plant Saves Steam*

BY HENRY MORGAN BURKE†

THE importance of the elimination of waste in a power department is probably generally recognized, but few, it is believed, realize that the cost of this department is second only to the payroll in a textile finishing plant.

For five or six years the author and his associates had studied the Mount Hope Finishing Company's power plant, which was rapidly depreciating and becoming daily less suited to meet the demands made upon it. After trying various expedients, they were finally forced to face the problem squarely and solve it in the most economical manner.

With the stimulation of a new boiler plant, work was begun on the devising of new methods by which the daily plant operation could be diagnosed, new operating practices introduced, the personnel enthused with the importance of their tasks, accurate records kept and schemes contrived to maintain higher efficiency without interruption.

With the provision of boilers with steam-flow meters, oil and steam-pressure gages, flue-gas analyzers and pyrometers, it was possible to run standardization tests. By rousing interest in the firemen and furnishing the chief engineer with the correct basis to work on, the progress made was rapid and certain, responsibilities were properly allocated, and detailed records were kept and *examined* daily. In this manner it became possible to establish an economical operating practice and standardize most of the influential conditions.

About 73 per cent of the steam generated was used directly for processing the goods and the remaining 27 per cent passed to engines, the exhaust of which was used for process, heating and warming up large quantities of water for various purposes. The distribution of steam presented a large problem as to metering, dispatching and elimination of losses.

The information gained from these studies brought the management to the realization that the organization of the power department should be changed. The chief engineer was thereupon made responsible for the generation of power and steam, and a power dispatcher was appointed and made responsible for the dispatching of the steam to the consumer and also for the elimination of losses.

The power dispatcher's job is a large one and a satisfactory one to perform. It is a position that requires tact, but once the right man is found, tangible savings begin. His specific duties may be grouped as follows: (A) Inspection of all distributing lines, conductors, valves, traps, etc., for the purpose of preventing any losses of heat, light and power in transmission; (B) investigations of the various manners in which steam, water and power are used for various purposes with the aim of devising and recommending more economical practice; (C) recording of steam, power and water consumption by various departments and preparation of reports and cost charges.

To insure the proper carrying out of this program, the authority and responsibility of the power dispatcher are clearly defined in writing. He has a separate office on the premises, adequately equipped with metering, calculating and recording facilities. His compensation is on a salary basis and he has no regular hours of work, as the nature of his duties does not permit observance of office hours. It is understood that he shall not be requested to work in excess of seventy hours a week, counting one hour of night or holiday work equivalent to two office hours. All foremen of all departments are expected to co-operate with the power dispatcher in the prosecution of his duties and the exercising of his authority, while any lack or failure of this co-operation is considered a breach of the company's discipline.

As soon as this office was instituted, a surprising number of possibilities for saving came to light at once. A plan of the piping layout was made. A systematic inspection of traps was started. Uses for condensate not fit for boiler-feed water were found either in the department itself or in an adjacent one.

To prevent the waste of steam, it was found necessary to make the consumer who wasted it pay for it. Here lay the greatest opportunity for saving and the greatest difficulty. All kinds of excuses were offered as to why such savings would affect the quality of the product at a so-called small saving of steam. For such a delicate task estimated consumptions were unsuitable. It was found necessary to install instruments for actual measurements.

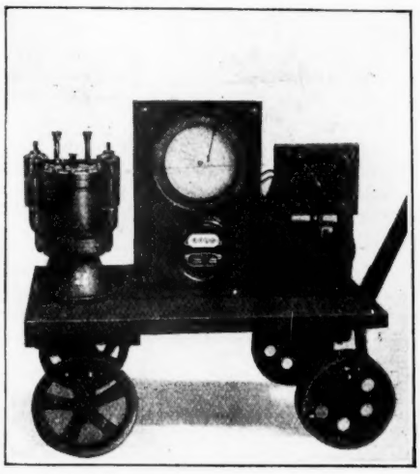


Fig. 2—Portable steam-flow meter for test purposes

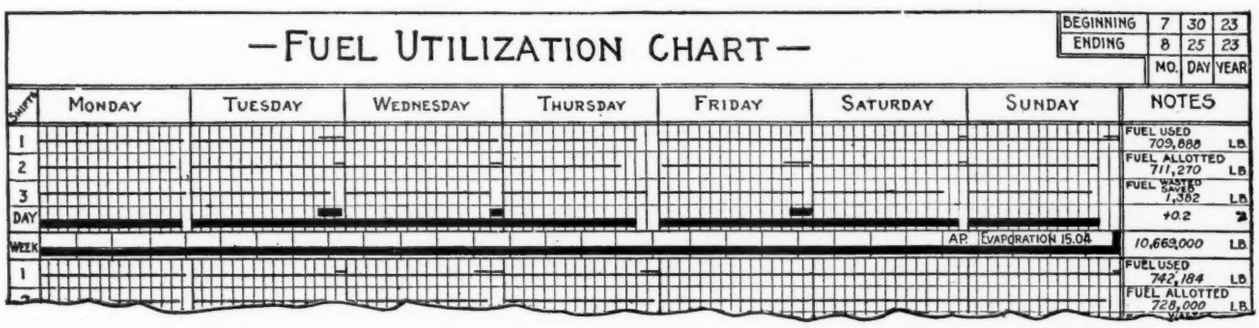


Fig. 1—This chart displayed in the boiler room sets a goal for each week, day and shift

The work was approached on a modest scale, taking the heavy users of steam first and installing a few meters on trial in their departments. The results were so gratifying that it was deemed advisable to continue the installation of meters until every pound of steam generated could be accounted for. To reduce the labor of reading, electrically operated instruments were installed, with all the dials and recorders mounted on a single board in

*Digest of a paper presented at the Annual Meeting of the A.S.M.E. in New York, Dec. 3 to 6, 1923.

†Engineer for Mount Hope Finishing Co., North Dighton, Mass.

the dispatcher's office, although in certain cases additional dials were installed near the consumer. In the additional control it gave the dispatcher over the system and in his ability to detect unusual losses at once and straighten them out by telephone, this centralized system quickly paid for itself.

The results have exceeded anticipation, as the savings made have greatly outweighed the expense incurred for meters, changes in pipe lines, investigations and research. Achnowledgment is made of the practical value of the method of mastering power production established by Walter N. Polakov, Consulting Engineer, New York, whose services were secured by the company in February, 1922.

At the time of writing this paper the evidence on record shows the following actual yearly savings: In generation, $39,760; in distribution, $12,320; in utilization, $24,800. The savings enumerated represent only a few items. The work is still in progress.

In the matter of records an endeavor has been made to simplify and keep to a minimum the number of forms to be made out daily and to crystallize the records for the generation of steam into one form known as the fuel-utilization chart. This chart, the top section of which is reproduced in Fig. 1, shows the daily performance for each shift, day and week by straight lines whose lengths represent the evaporation of water per pound of fuel. Each day, shift and week are spaced into fifteen sections, representing the evaporation of fifteen pounds of water "from and at" 212 deg. per pound of fuel oil. The amount by which actual performance falls short of or exceeds this "bogie" of fifteen pounds equivalent evaporation is indicated by the length of the white gap in the one case and additional short line (above) in the other.

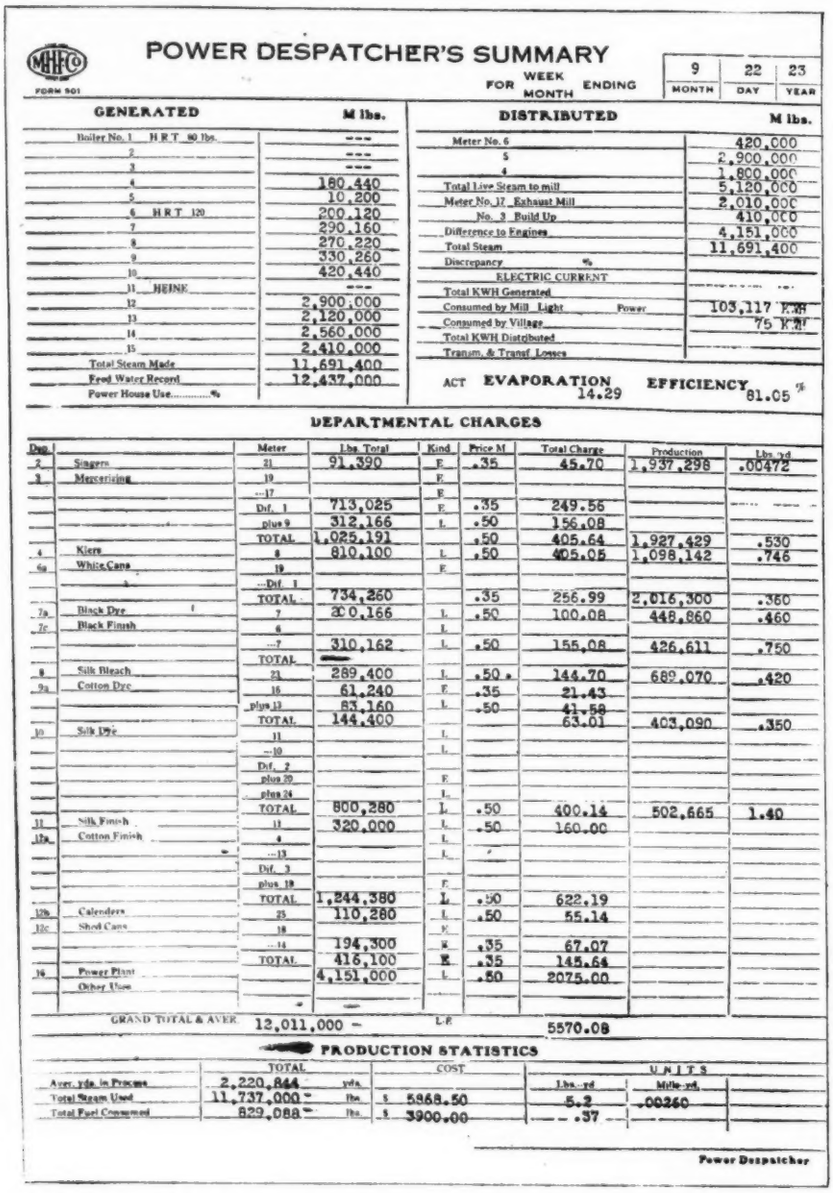
From the other graphic records of the flow meters of the dispatcher's office the power dispatcher recapitulates, condenses and compiles the statistics for the plant engineer. The power dispatcher's weekly summary is shown in Fig. 3.

One of the unique features of the system as operated, is that the power plant is virtually an independent business carried on within the walls of the plant. It buys its raw product, fuel, and sells the finished product, steam, to its customers in the various departments of the plant. It pays rent for its housing and also has to pay for insurance, taxes and other charges, labor and supplies. Consequently it must charge for its finished product, steam.

It sends out bills weekly to each department for steam used, as shown by the steam-flow meters, at cost of production. Exhaust steam costing less than high-pressure steam, its use wherever practicable is encouraged by a lower charge per thousand pounds.

For the benefit of the accounting and sales departments the power dispatcher prepares monthly a report showing the distribution of the power-plant expense to the various departments. This is accompanied by a statement of cost of various items that make up the total.

The intrinsic value of this system of conducting a power plant lies in its simplicity and elasticity. While it is being employed in a large steam plant costing one-third of a million dollars annually to operate, it is equally practical for a small plant.



POWER DESPATCHER'S SUMMARY

FORM 501

FOR WEEK / MONTH ENDING — 9 (MONTH) 22 (DAY) 23 (YEAR)

GENERATED — M lbs.

Boiler No. 1 H R T 80 lbs.	---
2	---
3	---
4	180,440
5	10,200
6 H R T 120	200,120
7	290,160
8	270,220
9	330,260
10	420,440
11 HEINE	---
12	2,900,000
13	2,120,000
14	2,560,000
15	2,410,000
Total Steam Made	11,691,400
Feed Water Record	12,437,000
Power House Use ..... %	

DISTRIBUTED — M lbs.

Meter No. 6	420,000
5	2,900,000
4	1,800,000
Total Live Steam to mill	5,120,000
Meter No. 17 Exhaust Mill	2,010,000
No. 3 Build Up	410,000
Difference to Engines	4,151,000
Total Steam	11,691,400
Discrepancy %	
ELECTRIC CURRENT	
Total KWH Generated	
Consumed by Mill Light Power	103,117 K.W.H.
Consumed by Village	75 K.W.
Total KWH Distributed	
Transm. & Transf. Losses	

ACT EVAPORATION 14.29 EFFICIENCY 81.05 %

DEPARTMENTAL CHARGES

Dep.		Meter	Lbs. Total	Kind	Price M	Total Charge	Production	Lbs. yd
2	Singers	21	91,390	F	.35	45.70	1,937,298	.00472
3	Mercerizing	19		F				
		--17		F				
		Dif. 1	713,025	F	.35	249.56		
		plus 9	312,166	L	.50	156.08		
		TOTAL	1,025,191		.50	405.64	1,927,429	.530
4	Kiers	8	810,100	L	.50	405.05	1,098,142	.746
6a	White Cans	19		F				
		--Dif. 1						
		TOTAL	734,260		.35	256.99	2,016,300	.360
7a	Black Dye	7	200,166	L	.50	100.08	448,860	.460
7c	Black Finish	6		L				
		--7	310,162	L	.50	155.08	426,611	.750
		TOTAL						
8	Silk Bleach	23	289,400	L	.50	144.70	689,070	.420
9a	Cotton Dye	16	61,240	F	.35	21.43		
		plus 13	83,160	L	.50	41.58		
		TOTAL	144,400			63.01	403,090	.350
10	Silk Dye	11		L				
		--10		L				
		Dif. 2						
		plus 20		F				
		plus 24		L				
		TOTAL	800,280	L	.50	400.14	502,665	1.40
11	Silk Finish	11	320,000	L	.50	160.00		
11a	Cotton Finish	4		L				
		--13		L				
		Dif. 3						
		plus 19		F				
		TOTAL	1,244,380	L	.50	622.19		
12b	Calenders	25	110,280	L	.50	55.14		
12c	Shed Cans	18		K				
		--14	194,300	K	.35	67.07		
		TOTAL	416,100	K	.35	145.64		
16	Power Plant		4,151,000	L	.50	2075.00		
	Other Uses							
	GRAND TOTAL & AVER.		12,011,000	L.P.		5570.08		

PRODUCTION STATISTICS

	TOTAL		COST		UNITS	
Aver. yds. in Process	2,220,844	yds.			Lbs. yd	Mills yd.
Total Steam Used	11,737,000	lbs.	$ 5868.50		5.2	.00260
Total Fuel Consumed	829,088	lbs.	$ 3900.00		.37	

Power Despatcher

Fig. 3—This sheet records the distribution of steam and charges to departments

Application of Ball and Roller Bearings to Electric Motors

On Saturday evening Jan. 5, at the Engineers' Club in Philadelphia, the Philadelphia section of the Association of Iron and Steel Electrical Engineers held its regular monthly meeting, at which the subject of ball and roller bearings was discussed. Two papers were presented: "Design and Application of Ball Bearings to Electric Motors," by T. C. Delaval Crow; and "Mounting and Maintenance of Roller Bearings in Electric Motors," by W. B. Wachtler. At the Association's convention held in Buffalo last year, a great deal of attention was given to the question of standardizing ball and roller bearings for electric motors. Although no definite action was taken at that time, it was agreed that all four local sections of the Association should devote one meeting this year to discussing this problem, and the Philadelphia meeting was the first to do this. It is expected that these meetings will bring out many important data on the problem of applying ball and roller bearings to electric motors and lead to the standardization of these types of bearings.

In presenting his paper, Mr. Crow said that a great deal of energy and money had been spent in the development and application of ball and roller bearings to electric motors and that great progress had been made. According to the speaker, a ball bearing that is operating properly does not wear, the streaks in the raceways are due to inequalities of the metal, and wear that might be thought to be indicated by this discoloring cannot be detected even by weight. There are slight friction losses in the bearings, and these losses have been found to be practically constant within normal speeds. Mr. Crow warned against using too tight a press fit for the inner raceway on the shaft, as this often caused the raceway to expand so much as to take all the clearance out of the bearing and made trouble. The method of locking the inner raceway to the shaft was mentioned, and it was pointed out that unless the raceway made a tight fit on the shaft it was impossible to hold it tight with a locknut. It has been found that ball bearings give just as long service under continuous loads as under intermittent loads. Although grease was recommended as one of the best lubricants for ball bearings the use of graphite in any form was strongly opposed as it has a tendency to accumulate in front of the balls and retard their motion.

Roller-Bearing Operation

Mr. Wachtler said that wide variations in load after bearings had been installed precluded close calculations being applied and that selecting bearings by calculations only was not safe. Where belts are used the maximum belt stress should be considered, and shock loads should be taken care of by reserve capacity in the bearings. The speed must also be taken into consideration, since the capacity of the bearings falls off with the speed. The speaker said that a roller bearing could have from $\frac{1}{8}$ to $\frac{3}{16}$ in. end play without affecting its operation. Either oil or grease may be used as a lubricant, oil being preferred. The oil used in these bearings, it was explained, should be free of acid and have a high flash point.

In the discussion it was brought out that there is a wide variation in the practice of lubricating ball or roller bearings; that where apparently some operators give little attention to this matter and allow the bearings to run for a year or more without renewing the lubricant, others lubricate the bearings once a month. It was suggested that a good basis on which to standardize ball and roller bearings is speed and horsepower. A point of disagreement was whether the balls in angular contact bearings were caused to spin in operation. One speaker claimed that they did and that for this reason an angular contact bearing would run warmer under the same load than a radial contact bearing. Polarized light was suggested as a means of determining the stresses in the inner race after it has been pressed on the shaft.

Proposed Standards for Identification of Piping Systems by Colors

THE identification of fluids conveyed by pipes in power houses and industrial plants has in the past been given some attention by various individual firms. In 1911 a committee of the American Society of Mechanical Engineers developed a color code for such identification of power-house piping. Since that time numerous other codes have been worked out by individual power plants and chemical manufacturing concerns. In 1921 this subject seemed to be of such increasing interest that at the request of the National Safety Council and the A.S.M.E., the American Engineering Standards Committee authorized the organization of a Sectional Committee to prepare a national code for this purpose and designated the N.S.C. and the A.S.M.E. as Joint Sponsors. At its organization meeting in June, 1922, this Sectional Committee authorized the appointment of a committee on Plan and Scope, of which W. S. Morrison was made chairman. The report of this Plan and Scope Committee which was presented to the Sectional Committee at a meeting held in November, 1922, called for the appointment of four committees: (1) Executive Committee with the chairman of the Sectional Committee, A. S. Hebble, as chairman; (2) Sub-committee on Classification, Crosby Field, chairman; (3) Subcommittee on Identification by Colors, F. P. Ingalls, chairman; (4) Subcommittee on Identification Markings Other than Color, W. S. Morrison, chairman.

The first of these sub-committees to complete its report is that on "Identification by Colors," F. P. Ingalls, chairman. This report is now in the hands of the members of the Sectional Committee for study before their next meeting, which will be held on Thursday, Jan. 10, 1924. In the meantime the committee desires to receive criticism and comment on this tentative draft of its report. These should be addressed to I. G. Hoagland, Secretary of the Sectional Committee on Code for Identification of Piping Systems, in care of the National Automatic Sprinkler Association, 80 Maiden Lane, New York City.

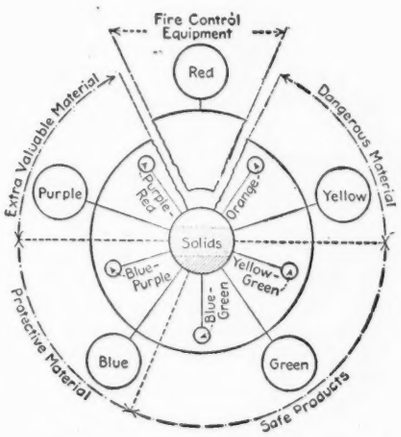
The following is taken from the tentative report:

It is obvious that to attempt to outline a code in which every product liable to be transported would have its identification, would result in a system so comprehensive that the supply of colors and identification symbols would not hold out. It is found upon investigation that any materials transported in pipes in a plant fall in one of the five following classifications:

Safe Products—This represents a majority of the products that are handled through a plant. Those products may be defined as having no hazard in their handling and no extraordinarily high value, so that a workman in approaching a piping system to make repairs will run no undue hazard in breaking into a pipe bearing a safe material, even though that material had not been emptied by previous arrangement.

Extra-Valuable Material—This might be classified as a part of the safe materials above mentioned, but inasmuch as cases came to your committee's attention where those products would have a very high value, it appeared preferable to give them a separate major classification.

Dangerous Materials—These materials are those which inherently in themselves are hazardous to life or property by virtue of being easily inflammable or productive of poisonous gases or are in themselves poisonous.



Five classes of pipes and colors assigned

They include, of course, materials that are known ordinarily as fire producers and explosives.

Protective Materials—Under this class fall materials which are piped through plants for the express purposes of being available to prevent or minimize the hazard of the dangerous materials above mentioned. Thus, a plant may have certain special gases which are antidotes to poison fumes, which gases are piped through their plants for the express purpose of opening or breaking the pipe in case of danger.

Fire Control Equipment—This might properly be called a division of the Protective Materials just mentioned, though the hazard of fire and the use of sprinkler systems and other fire-fighting equipment having become so universal, it would appear better to make it a special major classification.

The figure shows the proposed colors, and groups assigned. These five classifications or subdivisions thereof, if necessary, in the opinion of your committee should be each given a major color, and the various subdivisions that a plant may need can be obtained by

the use of numbers, names, or the like, painted in white or black upon a background of the color selected.

A plant atmosphere that will ordinarily support human life without material danger to general health, may at times be charged with gases or vapors that will react chemically on many paint pigments with a resultant change in color.

By far the most common of these abnormal forms of attack come from vapors that are acidic, alkaline or sulphureted. The dry gases are far less active, but when accompanied by aqueous vapor they penetrate the paint film and, if reactive with the pigment, cause rupture of the film and change of color by the formation of new compounds having a different volume and color from the original pigment.

In any plant where such abnormal conditions persist, the first step is to use a vehicle having the highest practical water resistance and then select colors in such a way that the pigment will have the least reactivity with the prevailing gas. The colors shown by the committee indicate some of the possibilities in this direction.

CHEMICALLY RESISTANT COLORS

Toluidin Red—Fairly fast to aqueous acids, alkalies and sulphur. An organic pigment that will stand up as well as the vehicle. Adds materially to the life of varnish vehicles and works well with all of them.

Paranitranilin Red—Similar to the toluidin and considerably cheaper, but owing to a slight solubility in the vehicle, it has a tendency to stain up through light shades or whites applied over it; for example, white letters or aluminum stripes.

A Mixed Pigment consisting of an organic red similar to toluidin mixed with zinc yellow—Fast to alkalies and sulphur but not to acids. Shades of orange may be adjusted to suit. Mixed with cadmium yellow in place of the zinc yellow it becomes fast to acids as well.

Orange Chrome Yellow—The regular color for ordinary use. Fast to alkalies but not to acids or sulphur.

Yellow Ochre toned up with bright yellow to a type commonly known as Golden Ochre—Ochre itself as compared with the more highly saturated hues is little more than a yellow brown, but in the proposed system where browns as distinctive colors are eliminated, the ochre falls unmistakably in the yellow sector. Owing to its general stability and low price it is the main reliance for fast yellow in situations where chrome yellows cannot be used. Like other iron compounds that contain hydroxyl groups or "chemically combined water," it is not wholly fast to sulphur. Strong ammonium sulphide darkens it somewhat but except in extreme cases it is fast to everything. When toned up to a brighter shade, the resistance depends on the kind and quantity of toner.

Cadmium Lithopone—A combination of cadmium sulphide and blanc fixe. Fast to everything, but applicable to extreme cases only because the available supply is limited and the cost relatively high.

Chrome Yellow L—The ordinary pigment for general use. Fast to acids, but not to caustic alkali or sulphur.

Chrome Oxide toned up with a little yellow to raise its total reflection value. This oxide is a moderately low priced oxide not to be confused with Vert de Guignet, a much more brilliant and expensive quality. It is fast to everything and useful in extreme cases.

Ordinary Chrome Green Light—Fast to weak acids, but not to alkali or sulphur.

Prussian Blue tint with a base white of Titanox—Fast to acid, fairly resistant to sulphur, easily affected by alkali.

Ultramarine Blue tint with base white of zinc oxide—Fast to alkalies and sulphur but not to acids.

Base white of Titanox tinted with Alizarine Purple—Fast to everything. Shade can be adjusted by adding Alizarine Red in varying proportions.

A Gray and a Black—Included for comparison and incidental interest.

For ordinary outside exposure linseed oil is the most durable vehicle. Where higher resistance to water is required and for interior use, China wood oil varnishes may be used to advantage. Where both these vehicles fail, some type of coating other than ordinary paint must be selected or the identification by color abandoned.

Who Was Responsible for Carelessness?

BY A. L. H. STREET

An employer's responsibility for negligence on the part of his engineer was the subject of consideration in the case of Bush vs. Sinclair-Rooney & Co., 201 New York Supplement, 804, decided by the Appellate Division of the New York Supreme Court.

Stuber was employed by the defendant to operate boilers. A defect developed in one of them, and Howard Brothers & Co., boiler makers, were employed to make repairs. They sent four expert employees to do the work, and Stuber was asked by the foreman to provide a quantity of kerosene for use in a lighting and heating device used in the work. Through mistake he furnished gasoline, the explosion of which killed Stuber and three other persons. Holding that the defendant might be held responsible for the accident, as to men other than Stuber killed, on a theory that Stuber's negligence occurred in the course of his employment, the Supreme Court said:

Throughout this time, Stuber was in the general employ of the defendant. He was never in the general employ of Howard Brothers & Co. While his duties are not specifically shown, he is called the engineer, which, of course, included the firing of the boiler, and a jury could say that it included such ordinary repairs and work about the boiler as an ordinary mechanic would do. While the boiler makers were there, he seems to have been interested to get the work done and to be generally helpful. "A master is liable for the result of a servant's negligence, when the servant is acting in his business—when he still is engaged in the course of his employment. It is not the rule itself, but its application, that ever causes a doubt." . . .

We are not called upon to determine whether a jury might not have found that Stuber was not engaged in the defendant's business, but whether it can be said, as matter of law, that he was not engaged in the defendant's business. Howard Brothers & Co. were independent contractors, doing but one thing, namely, repairing the boiler. . . . Stuber unquestionably did certain minor things to assist the independent contractors in their work, but a jury could have found that the helping of the independent contractors was for the benefit of the defendant. We do not know what orders Stuber had. It does not appear whether or not he disobeyed any given to him. But even a disobedience of orders is not the determinative fact of whether the work is within the scope of an employee's duties. . . . Nor will a slight deviation, even for the servant's own benefit, from the course of work required by the master, necessarily relieve the master from liability for an accident occurring during the period of such deviation. . . .

In the present case, the general employment of Stuber by the defendant being unquestioned, the acts done not in furtherance of his own purposes, we find no evidence from which we can say, as matter of law, that command was surrendered, unless we draw an inference of such surrender from the mere fact that the purpose of Stuber's acts were to advance both the business of his employer, the defendant, and of the independent contractors, which, under authority of the last citation, we may not do.

In our opinion, a jury would at least have been entitled to say that the acts of Stuber were done in the course of his service in his employer's business, and, that being so, the nonsuit was erroneous.

Since Japan is especially poor in coal and petroleum resources its manufacturing plants have been more or less dependent upon hydro-electric power, and its ability to compete in world markets will depend to a great extent upon future development of this resource. The numerous short, swift rivers found in Japan have caused the development of electricity by water power to far outstrip that produced by steam, especially during the last decade. In 1910 the amounts produced by steam and by water power were about the same, but at the end of 1919 out of a total of 572,000 kw. produced by commercial light and power companies, 487,000 kw. was generated by water power, while only 94,000 kw. was produced by steam. The total production of all plants including private and government, during 1919 amounted to 1,133,000 kw., or about one-sixteenth that of the United States for the same period.

Recent Publications

A Treatise on Engine Balance Using Exponentials. By P. Cormac, Fellow of the College of Science for Ireland. Published by E. P. Dutton & Co., New York, 1923. Cloth; 5½x8½ in.; 151 pages; 55 illustrations. Price, $8.

The designer of engines or the investigator of phenomena along this line will doubtless be interested at the clear and comprehensive manner in which these subjects are analyzed and the mathematics handled. The author begins by a simple explanation of the parallelogram law, representing the use of vectors, and the interpretation of the iota. Cyclic factors for rotation, exponential form of cyclic factors, as well as methods of handling, graphical representations, etc., are taken up at the beginning. The remainder of the eleven chapters cover the symmetrical engine, piston displacement, inertia-force, and effects of piston mass, etc. Following this various types of engines are considered. The mathematical equations are illustrated by examples worked out at length and with many illustrations. An appendix contains examples of expansion of functions in trigonometric series. In conclusion it is felt that the careful division of the subjects given in the table of contents, together with the index, assists materially in making this a practical and easily understood work.

Heat Transmission Within the Internal Combustion Engine (Der Waermeuebergang in der Verbrennungskraftmaschien). By Prof. William Nusselt. Published in German by the Verein Deutscher Ingenieure, Berlin, Germany. Paper, 7⅞x10⅝ in.; 15 illustrations; 79 tabulations. Price not stated.

This book seeks to show by mathematical deduction and laboratory experiments the propagation of heat by hot gases and the heat transmitted to the cooling water by radiation and conduction of the cylinder walls of the internal-combustion engine.

The cooling of hot gases is first investigated by careful temperature measurements with gases exploded within steel spherical bombs of various diameters. To segregate the effect of radiation and conduction, the inner surfaces of otherwise identical bombs were gold plated in some and coated with lampblack in others. The observed values are, however, not applicable to the engine cylinder in which the moving piston imparts a whirling motion to the gases, which serves to increase the conductivity of the cylinder walls. By careful measurement of the cooling effect of a stream of air directed against a hot metal wall and comparing the results with those obtained by Clerk and other experimentors, along similar lines, a formula is derived for calculating the heat absorbed in the cooling water through conduction by the cylinder walls, under given temperature and gas density with a given mean piston speed.

The work is scholarly but systematic in its presentation. It is of chief interest to the designer of gas and Diesel engines and is of value to the advanced student of physics.

Studies in the Economics of Overhead Costs. By J. Maurice Clark, Professor of Political Economy, University of Chicago. Published by The University of Chicago Press, Chicago, Illinois. Cloth; 5½x8½ in. 502 pages; 24 chapters; no illustrations. Price $4.

This book was not originally planned as a commercial text, but rather as the basis of a course of lectures for students. The author has endeavored to put this in argumentative form so that business men would find it readable, if they were willing to deal with some few unfamiliar terms and to accept the viewpoint of a search for the laws of economic efficiency rather than that of the narrow commercial efficiency which breeds the convulsions that sap the strength of business as a whole, to quote largely the language of the author.

Those looking for thoughts or ideas along the line of efficiency will undoubtedly find some information in these pages. The author has quoted freely from other authorities, so that a large amount of comparative information is represented. On the other hand, the work is so argumentative in character that it is quite difficult for a practical business man to correlate some of the statements with the actual facts of business. For instance, on page 114 the author makes the statement, "efficiency is a proportion between things you want and things you do not want, and some of these things are bound to increase faster than others, as the working units get bigger."

This rather unusual definition of efficiency evidently pertains to efficiency of construction or proportion rather than that of production. With many it would seem that efficiency is rather out of place in connection with such a conception, as this ordinarily refers to dynamic processes rather than structural objects. The author explains further by comparing the various items that change, as the size of a ship is increased. Wetted surface ordinarily increases about as the square of one dimension and the cubical contents almost as the cube.

To those who are not familiar with engineering or physical principles, the many arguments will undoubtedly bring information. To the business man, however, it would seem that a good analysis of the facts would make many of the arguments unnecessary and be of great assistance in presenting the subject in a practical manner.

The Action of Engine Shaft Governors (Der Regelvorgang ber Kraftmaschinen). By A. Watzinger and Leif J. Hanssen. Published in German by Julius Springer, Berlin, Germany, 1923. Paper, 8x11 in.; 92 pages; 82 illustrations. No price stated.

This publication is the outcome of a series of calculations and experimental determination of the extent and character of the resultant forces set up within engine-shaft governors by the oscillating external reaction of the valve gear and the internal friction of the governor to resist the displacement of the eccentric. These forces have a retarding effect on the governor movement which can be likened to that which would be produced by an oil brake. They are nearly proportional to the rate of the governor travel, and the experiments conducted by the authors at the Trondhjem (Norway) Technical High School Laboratory show that they consume the major portion of the power required to operate the governor. The power required to accelerate the governor masses is exceedingly small in comparison to the former. The presentation is highly technical and involves a great number of differential equations that call for a considerable knowledge of calculus to follow them.

Four governors are taken under consideration: The Harting and Kuhn; the Wolf, as used on the locomobile; the Jahns; and a special experimental governor with a relatively great inertia effect, designed and constructed at the Trondhjem Laboratory.

The first chapter is devoted to a description of the governors with dimensions, weights of reciprocating engine parts and mean inertia effects, together with a description of the testing equipment. Special recording instruments were used to facilitate the simultaneous comparison of the factors under consideration wherever necessary. The succeeding chapters deal with the action of the governors under load changes; the influence of the valve-gear reaction with and without consideration of the internal governor friction and the latter in combination with the friction of a slide valve and a piston valve; the power required to operate the governor and the ratio between this and the rate of governor travel; the influence of the internal friction, the degree of stability and the inertia effect of the governor parts on the governor action; the determination of the ultimate capacity of the governor; the influence of changes in the weight of the governor parts on the distance of the governor travel, the influence of the governor travel on the ratio between the power consumption and the rate of travel; a detailed comparison between the calculated and actual governor movements with numerous examples, the calculated changes in the engine speed and the influence of the inertia effect on speed changes, and conclude with a brief review of the factors to be considered in designing a typical eccentric shaft governor.

Nine Southern Power Companies Make Offer for Muscle Shoals

Offer Leaves Nitrate Plant with Adequate Power Free for Ford or Other Manufacturer

SOUTHERN power companies have made a tentative offer of $100,000,000 for utilization of the power at Muscle Shoals for fifty years. The offer was presented in a letter to the Federal Power Commission and was made public by Representative Hull, of Iowa, a member of the House Military Affairs Committee.

Under the plan, said Mr. Hull, Henry Ford would be allowed to take over the nitrate plants and operate them for fertilizer manufacture if he wished. The offer does not include these plants, but specifically provides that a large block of power shall be reserved for fertilizer production.

At present, Mr. Hull said, Mr. Ford's plan is inadequate from the standpoint of public benefit or of a return to the government of its war-time investment of $107,000,000, whereas the power companies' proposal would insure a proper return.

Mr. Hull made the following statement:

The outline of a proposed tender to the Government for the utilization of the power at Muscle Shoals, as made by a group of Southern power companies in response to an inquiry by the Federal Power Commission initiated at my request, is the most practical solution yet advanced for one of the most troublesome problems with which Congress has had to deal.

The nine companies associated in making a new offer for the Muscle Shoals power plants propose to organize a company to lease the plant for fifty years under the terms of the Federal Water Power Act and to agree to pay to the government a rental sufficient to meet all interest charges on expenditures on the project to the time of its completion, including the $17,000,000 expended during and just after the war. This total, the companies estimate will approximate $45,000,000, if the government installs eight contemplated generating units in the hydro plant.

The sum of $4,500,000 would be added for the value of the present government steam plant at Muscle Shoals, bringing to $50,000,000 the total on which interest charges are to be computed. On this sum the companies offer 4 per cent which would return to the government, in the way of rent, $2,000,000 a year. If the government should install more than eight generating units, the companies would increase their return to the government accordingly. If the government desired to sell the Muscle Shoals steam plant, one of the proposing companies would undertake to buy it at a price of $4,500,000 on terms satisfactory to the government. The rent for the first six years would be at the rate of $300,000 a year, and for the next four years $1,500,000 a year, increasing the following year to the maximum.

During the first few years the companies propose to spend not less than $10,000,000 for new transmission lines and equipment to deliver the power for commercial and business uses in the South by means, in part, of the so-called superpower system conceived during the war, and by which power transmission lines in Tennessee, Georgia, Alabama and North and South Carolina are interconnected. By this plan the companies exchange power as demands require and an excess of water power at any one point is made available for public need at other points.

The project would be subject to recapture by the government at the end of the fifty-year lease, as provided by the Federal water-power law. The government would have the right to take possession of the property whenever the safety of the United States demanded for manufacture of nitrates, explosives or munitions.

The letter to the Federal Commission is written from the office of the Tennessee Electric Power Co., which is said to be a subsidiary of the Alabama Power Co. It is signed by the Tennessee concern, the Columbus Electric & Power Co., Carolina Light & Power Co., Yadkin River Power Co., Ashville Power & Light Co., North Carolina Electrical Power Co., Memphis Power & Light Co., Alabama Power Co. and Central Georgia Power Company.

The statement is made that the entire Muscle Shoals power can be absorbed in the South within ten years, and may be transmitted all over Tennessee, the Carolinas, Georgia, Alabama, Louisiana and Mississippi.

F. A. E. S. Elects Hartness President

Reorganization of Federal Departments Endorsed

AT A MEETING of the Federated American Engineering Societies held in Washington, D. C., on Jan. 10, ex-Governor James Hartness of Vermont and a former president of the American Society of Mechanical Engineers, was elected president, to succeed Dean Cooley of the University of Michigan. At an all-day session on Wednesday, participated in by approximately one hundred organizations from all parts of the United States, the national public works conference held under the auspices of the Federated American Engineering Societies, adopted a resolution favoring a re-organization of federal departments. No particular plan was indorsed, the resolutions embodying the aims of the engineers, architects, contractors and allied bodies, merely stating: "This conference particularly endorses grouping and coordinating within an existing department, preferably renamed department of public works, the construction and administration of all non-military public works."

At the suggestion of Calvert Townley, a past-president of the American Institute of Electrical Engineers, the federation went on record as favoring an engineering investigation of the St. Lawrence-Great Lakes waterway before the matter was definitely presented to the American and Canadian governments. The chief speaker at Wednesday's meeting was Secretary Hoover of the Department of Commerce, and the first president of the engineering federation. Mr. Hoover said that no isolated bills for government re-organization could pass Congress and that the problem of regrouping public works functions was inseparably tied up with the larger problem of general reorganization.

Segregation of vast public works functions, in his opinion, must be accompanied by parallel segregation of other activities. He also asserted that the creation of a new public works department with a secretary as a member of the president's cabinet was out of the question. Executive Secretary L. W. Wallace of the Federation, said that Secretary Work of the Department of the Interior, was in sympathy with the movement to make over the latter department by the creation of a division of public works and a department of public domain.

Hoover Gets Opinion of Attorney-General in Regard to Gathering Trade Association Statistics

Attorney-General Draws Distinction Between Permissible Collection of Statistics and Methods That Would Prevent Free Competition

MR. HOOVER, Secretary of Commerce, wishing to clarify the legality of the activities of trade associations in the gathering and distribution of trade statistics, has taken the matter up with the Attorney-General for an opinion.

The chief points of Mr. Hoover's communications covered the following:

The question of the right of trade associations to gather and distribute information and statistics is becoming more and more acute. My own impression is that the collection and distribution of current unidentified information and statistics as to production, stocks on hand, and prices on closed transactions should be permissible provided it is all made available on fair terms, not only to the association members, but to all others interested, including the general public.

Such knowledge is essential to the consumer, producer, manufacturer and distributor, as it places them all in a position to interpret and judge market conditions intelligently on the basis of supply, demand and current prices, and to gage their purchases and sales accordingly.

If business be compelled to operate without such vital information, it will naturally be forced into unscientific and highly speculative avenues.

Competition based on fair and equal information of existing conditions would more likely result in lower prices to the consumer than competition based on uncertainty, in which each dealer must add something to his price to cover unforeseen eventualities.

Mr. Hoover states that the needs of his department for such statistics being great and that the gathering of them by the department being a gigantic physical task, he had asked and had obtained splendid co-operation from the trade associations in gathering such information. He further states:

My attention has been directed to a decree entered Nov. 26, 1923, in the District Court of the United States for the Southern District of Ohio, in the case of United States vs. Tile Manufacturers Credit Association, et al, paragraph 2 of page 3 of which is as follows:

"Provided, however, that the defendants may, through the association, or corporation hereinafter provided for, receive and compile for transmission to any governmental agency such information and statistics as it may request as to the production, shipments, the stocks on hand and the prices of tiles, but are restrained from distributing said information among themselves, except that information respecting sales may be collected annually and used to enable the assessment of the several members for their proportionate parts of the several expenses of the association, and for no other purpose."

The Attorney-General quotes extensively from former correspondence with the Commissioner of Commerce in regard to the collecting and distribution of statistics by trade organizations and states that two objects had been in mind then:

First, that the information distributed should be general, and second, that individual contact between those engaged in the same industry with reference to matters which vitally affect prices should be avoided. If the character of the information and the manner of its dissemination be restricted, one member would not be informed as to the individual activities of another member, and those engaged in the industry would be prevented from revealing their business to their competitors. Under the system now practiced by many of the associations, each member reports its production, shipments, stocks on hand, and each individual sale, stating the price at which it is made and, generally, the locality where made; and this information is distributed by the secretary or manager of the association among all the members, though in some associations the names of the members making the sales are omitted. Thus each member reveals the details of his entire business to every other member, which, as suggested by the Supreme Court in the Hardwood case, is entirely inconsistent with the normal attitude of real competitors.

In my judgment the effect of general information as to the conditions of an industry, such as the total production, shipments, stocks on hand and the average price, or range of prices, is entirely different from that resulting from each person engaged in an industry receiving directly, or through a common medium, reports which reveal to him the exact condition of the business of all of his competitors. When thus informed each one is invited, and is naturally inclined, to imitate the conduct of his most successful competitor; and the spirit of comradship created by the confidential exchange of information of this character necessarily prevents the free competition between them which would otherwise prevail.

Those who organize and conduct these associations appear to entertain the idea that if the information imparted relates only to past and closed transactions, there can be no violation of the Anti-Trust Act. In my judgment such an idea is wholly fallacious. One's future conduct is to be judged by what he has done and is then doing, and not so much by what he says he will do. It is one's actual conduct that is taken as an example for imitation. It has developed in the trial of cases involving associations that the members could not be relied upon to keep the agreement; and the system of exchanging statistics was adopted because it was found to be the only effective way to procure co-operation as to prices and production; and such co-operation could be thus procured even in the absence of any positive agreement.

Again, the idea seems to be prevalent that no exchange of information between the members, regardless of its extent or character, can be unlawful if at the same time publicity be given thereto through the press or some governmental agency. In my judgment this idea is likewise fallacious. The illegality as well as the evil results arise from the co-operation among the members pursuant to a positive or tacit understanding; and this co-operation is not affected by publicity. Those who purchase the commodity, though fully informed as to the activities of the association, can protect themselves only by an organization and co-operation of like character, which, if it were lawful, is an impossibility upon the part of the public.

I have no doubt that it is important that those engaged in an industry have general information as to the conditions of that industry, but I think that information should be distributed strictly through a responsible medium, like your Department; and I see no objection to its being gathered by an association provided it be strictly guarded and the association be prohibited from distributing it among its membership. This is the same view that I entertained when the communications were exchanged in February, 1922; and it has since been strongly confirmed by decisions of the Supreme Court and by investigations of a number of associations and the trial of cases involving associations.

Two Penstocks Burst in California

On New Year's Day a penstock at the Big Creek No. 8 plant, of the Southern California Edison Co., burst, and the escaping waters caused the death of two women. The cause of the break has not been learned. About two years ago a failure occurred in this same penstock due to a defective steel manhole casting. This defect being caused by a slag pocket in the casting. The penstock is 2,800 ft. long, 8 ft. in diameter at the top end and 6 ft. at the power house. It supplies a 22,500-kw. unit operating under a 680-ft. lead. The plates vary in thickness from $\frac{3}{8}$ to $1\frac{1}{4}$ in.

A break occurred in the penstock at the new Eldorado plant of the Western States Gas & Electric Co. on the American River on Jan. 2, while the penstock was being filled for the first time. The break was near the power house, and no serious damage was done except to the pipe itself. The rupture was about six feet long and sixteen to eighteen inches from a longitudinal weld and parallel thereto. The escaping water under a head of about 1,800 ft. forced the break open to a width of about one foot. The penstock consists of 30-in. lap-welded pipe in 20-ft. section at the point where the break occurred. The damage will be repaired by installing a new section of pipe. The accident will delay the opening of the plant until the middle of the month.

Canadian Imports of Coal Increasing

The coal statistics of Canada for the 10 months ended Oct. 31 show that the total importation of coal during this period was 19,450,000 tons, an increase of 43 per cent over the preceding three-year average for the same period. Of this coal 4,315,800 tons was anthracite, an increase of 34 per cent over the three-year average.

Commission Seeks Injunction Restraining Girand

The Department of Justice has before it a request from the Federal Power Commission to seek, as promptly as possible, an injunction requiring James B. Girand to discontinue construction work on his project at Diamond Creek on the Colorado River.

While Mr. Girand holds a license from the State of Arizona, which would have expired on Dec. 26, 1923, had he not begun this work, the Federal Power Commission contends that his present activities are being undertaken before the requisite action by that body has been taken. The Federal Power Commission is withholding a license covering the project in the hope that a general policy may be agreed to among all the states in the Colorado River basin before any licenses are issued by the Federal Government.

Society Affairs

The Utah Section of the A.S.M.E. will hold an informal dinner and smoker to discuss A.S.M.E. affairs on Jan. 22 at the University Club.

The Boston Section of the A.S.M.E. will have an illustrated paper on "Recent Developments on Steam Locomotives" at its Jan. 22 meeting.

The Rochester Section of the A.S.M.E. will hear Louis W. Arny speak on "Belt Transmission and Leather Belting," at its Jan. 23 meeting, which will be held at the University of Rochester.

The Engineering Society of Western Massachusetts will at a dinner and regular meeting at the Highland Hotel, Springfield, Mass., hear A. C. Eaton, of Worcester, Mass. give an illustrated talk on the "Davis Bridge Dam." Jan. 21 is the date of the meeting.

Personal Mention

Paul H. Brangs, for many years a director and vice-president of the Heine Boiler Co., has retired from active business and is going to make a tour around the world. He sails by the steamship "Resolute" on Jan. 18 and will be absent about six months.

William S. Johnston with Day & Zimmerman, Inc., Philadelphia, Pa., has been superintendent on the mechanical equipment of the new 25,000-kw. power plant just completed at Saxton, Pa., for the Penn Central Light & Power Co. Mr. Johnston was formerly identified with the Babcock & Wilcox Co. and the Westinghouse Electric & Manufacturing Co.

Coming Conventions

American Electrochemical Society. C. G. Fink, Columbia University, New York City. Meeting at Hotel-Bellevue-Stratford, Philadelphia, Pa., April 24-26.

American Institute of Electrical Engineers. F. L. Hutchinson, 29 West 39th St., New York City. Midwinter convention at the Bellevue-Stratford Hotel, Philadelphia, Feb. 4-8. Spring convention at Birmingham, Ala., April 7-10.

American Institute of Mining and Metallurgical Engineers. F. F. Sharpless, 29 West 39th St., New York City. Annual meeting at New York City, Feb. 18-21.

American Society of Civil Engineers. John H. Dunlap, 29 West 39th St., New York. City. Annual meeting at New York City, Jan. 16-18.

American Society of Heating & Ventilating Engineers. C. W. Obert, 25 West 39th St., New York City. Annual meeting at New York City, Jan. 22-25.

American Society of Mechanical Engineers, Calvin W. Rice, 29 West 39th St., New York City. Spring meeting at Cleveland, Ohio, May 10-12.

American Society of Safety Engineers. Genevieve S. Wood, 29 West 39th St., New York City. Annual meeting at New York City, Jan. 18.

Eastern Geographic Division of the **National Electric Light Association.** Meeting at Adelphia Hotel, Philadelphia, Jan. 16.

Engineering Institute of Canada. Fraser S. Keith, 176 Mansfield St., Montreal, Canada. Annual general Meeting at Montreal, Quebec, Jan. 22—Ottawa, Ontario, Jan. 23-24.

Engineers' Club of New York. Joseph Struthers, 32 West 40th St., New York City. Annual meeting on Jan. 22.

Franklin Institute. R. B. Owens, 15 South Seventh St., Philadelphia, Pa. Annual meeting Jan. 16, 1924.

Indiana Engineering Society. Charles Brossman, 1503 Merchants Bank Bldg., Indianapolis, Ind. Annual meeting at Lincoln Hotel, Indianapolis, Ind. Feb. 14-15.

Iowa Engineering Society. Blanche Veig, Acting Secretary, 406 Flynn Bldg., Des Moines, Iowa. Annual meeting at Cedar Rapids, Jan. 29-Feb. 1, 1924.

Master Boiler Makers Association. H. D. Vought, 26 Cortlandt St., New York City. Meeting at Chicago, May 20-23, 1924.

National District Heating Association, D. L. Gaskill, 112 West Fourth St., Greenville, Ohio. Annual convention at New York City, June 11-14, 1924.

National Electric Light Association. M. H. Aylesworth, 29 West 39th St. New York City. Annual convention at Atlantic City, Young's Million-Dollar Pier, May 19-24.

National Marine Engineers' Beneficial Association. Geo. A. Grubb, 313 Machinists' Bldg., Washington, D. C. Annual Convention at Franklin Square Hotel, Washington, D. C. Jan. 21-26.

Society of Automotive Engineers, Coker F. Clarkson, 29 West 39th St., New York City. Annual meeting at General Motors Bldg., Detroit, Mich., Jan. 22-25.

Society of Industrial Engineers. George C. Dent, 608 South Dearborn St., Chicago, Ill. Eleventh annual convention at Buffalo, N. Y., April 30 to May 2, 1924.

Business Notes

The Armstrong Cork & Insulation Co., Pittsburgh, Pa., announces that its Minneapolis office is to be at 316-320 Third Ave., North, Minneapolis, Minn.

The Quaker City Rubber Co., announces that it has removed all departments of its organization to Wissinoming, Philadelphia, Pa.

The Universal Engineers, Inc., No. 2 Downing St., Worcester, Mass., are now handling the business formerly conducted under the name of the Ground Coal Engineering Corp.

The Dayton-Dowd Co., manufacturer of centrifugal pumps, Quincy, Ill., announces the opening of consolidated sales offices at 30 North Michigan Ave., Chicago, Ill.

Manning, Maxwell & Moore, Inc., announce that Charles Stepan has been appointed Western sales manager of their industrial brass goods department, with headquarters at 27 North Jefferson St., Chicago, Ill.

Trade Catalogs

Condensers — Allis-Chalmers Manufacturing Co., Milwaukee, Wis. Bulletin 1539 describes with numerous illustrations surface, jet and barometric condensers as well as auxiliaries.

Instruments—Foxboro Co., Inc., Foxboro, Mass. Bulletin No. 96-I is a compact folder describing the different types of indicating, controlling and recording instruments manufactured by this company.

Pumps, Motor Driven — De Laval Steam Turbine Co.. Trenton, N. J. Catalog "Efficiency Tests of De Laval Steam Motor Driven Pumps," shows illustrations of some installations and includes tables of efficiencies.

Commutator Stones—The Martindale Electric Co., Box 35 Lakewood Branch, Cleveland, Ohio. Leaflet, "Imperial Commutator Stones," gives directions for ordering and also ten commandments in regard to the stones.

Refractories—Bernitz Furnace Appliance Co., 177 State St., Boston, Mass. Catalog, "Clinker-Proof Long Life Furnace Walls," shows with diagrams and photos of installations, the adaptability and use of these blocks for furnace walls.

Blowers, Volume — Johnson Fan & Blower Co., 115 South Clinton St., Chicago, Ill. Catalog No. 12, Section 2, is an eight-page pamphlet devoted to the new line of Johnson type V volume blowers with complete specifications for motor-and belt-driven units.

Instruments, Portable, Direct Current —Roller-Smith Co., 233 Broadway, New York City. Bulletin No. 210 describes ammeters, milli-ammeters, voltmeters, milli-voltmeters, volt-ammeters, galvanometers, shunts and multipliers of various types put out by this company.

Heater, Feed Water—Fulton Foundry & Machine Co., Cleveland, Ohio. Bulletin covering this unit system of heating feed water.

Exhaust Head, Multiport—Fulton Foundry & Machine Co., Cleveland, Ohio. Bulletin giving general data and dimensions.

Tubes, Steel—National Tube Co., Frick Bldg., Pittsburgh, Pa. Catalog "Shelby Seamless Steel Tubes and Their Making," describes with numerous and interesting illustrations the processes of manufacturing these tubes as well as other necessary and useful information.

Tube Cleaners—The Lagonda Manufacturing Co., Springfield, Ohio. Catalog X-7 contains 44 pages of information on Lagonda cleaners for use in boiler tubes of all sizes and types. Cleaners for use in economizer tubes, water backs, superheater tubes, large pipes or tubes, condensers and evaporators, etc., are also shown.

Fuel Prices

BITUMINOUS COAL

The following table shows the trend of the spot steam market in various coals (mine run bases, f.o.b. mines):

Coal	Market Quoting	Dec. 31, 1923	Jan. 7, 1924
Pool 1	New York	$3.25	$3.25
Smokeless	Columbus	2.00	2.00
Clearfield	Boston	2.25	2.25
Somerset	Boston	2.50	2.50
Kanawha	Columbus	1.75	1.75
Hocking	Columbus	2.00	2.00
Pittsburgh No. 8	Cleveland	1.90	2.00
Franklin, Ill.	Chicago	2.50	2.50
Central, Ill.	Chicago	2.25	2.25
Ind. 4th Vein	Chicago	2.75	2.75
West Ky.	Louisville	1.90	1.75
S. E. Ky.	Louisville	2.00	1.90
Big Seam	Birmingham	2.15	2.15

FUEL OIL

New York—Jan. 10, light oil, tank-car lots, 28@34 deg. Baumé, 4½c. per gal., 36@40 deg. 4¾c. per gal., f.o.b. Bayonne, N. J.

St. Louis—Jan. 2, tank-car lots, f.o.b. St. Louis; 24@26 deg., $1.65 per bbl.; 26@28 deg., $1.70; 28@30 deg., $1.75; 32@36 deg., gas oil, $1.90 per bbl.; 36@40 deg., distillate, $2.05 per bbl.

Pittsburgh—Dec. 27, f.o.b. local refinery, 30@34 deg., fuel oil, 4¾c. per gal.; 36@40 deg., fuel oil, 5c.; 34 deg., neutral 8c. per gal.

Dallas—Jan. 4, f.o.b. local refinery, 26@30 deg., $1.30 per bbl.

Cincinnati—Jan. 8, tank-car lots, f.o.b. local refinery, 26@30 deg. Baumé, 4¾c. per gal.; 30@32 deg., 5¼c.; 38@42 deg., distillate, 6c. per gal.

Philadelphia—Jan. 3, 28@30 deg., $1.78½@$1.82½ per bbl.; 18@22 deg., $1.68@$1.71½; 13@16 deg., $1.57½@$1.60½ per bbl.

Boston—Jan. 1, tank-car lots, f.o.b. heavy oil, 12@14 deg. Baumé, 4½c. per gal.; light oil, 28@32 deg. Baumé, 6½c. per gal.

Chicago—Jan. 8, 24@26 deg., $2.12 per bbl.; gas oil, 32@36 deg., 4.93c. per gal.

New Plant Construction

Ala., Birmingham—The Alabama Power Co., is perfecting plans for enlargements in its steam-operated generating plant on the Warrior River, Walker County, used for emergency service, to include the installation of a 20,000-kw. generating unit, and auxiliary equipment, estimated to cost more than $500,000.

Ariz., Phoenix—R. C. Baker and Charles Dunlap have plans under way for the erection of an ice-manufacturing plant on property recently acquired at Grand Avenue and Ninth Street, estimated to cost $75,000.

Ark., Arkansas City—The Roxana Petroleum Corporation, Arcade Building, St. Louis, Mo., will install pumping equipment, boilers, tanks and auxiliary power equipment in connection with the construction of two additional units at is local oil refining plant.

Ark., Magnolia—The Common Council plans for the installation of a pumping plant at its proposed waterworks and sewerage system. It is expected to arrange bonds in the near future.

Calif., Alhambra—The Carling Shoe Mfg. Co., F. G. Carling, president, recently organized, plans for the construction of a power house in connection with its proposed local plant at Mission Road and South Palm Avenue, estimated to cost $85,000.

Calif., Azusa—The Paramount Motors Corporation, Fred S. Lack, 507 California Bank Building, Los Angeles, president, has authorized a power house at its proposed local automobile manufacturing plant, consisting of a number of buildings, estimated to cost $1,200,000, with machinery.

Calif., Los Angeles—The Haines Canyon Water Co., plans for extensions and improvements in its pumping plants and system to cost about $80,000. Permission to issue bonds for the work has been secured from the State Railroad Commission.

Calif., Santa Monica—The Board of City Commissioners plan for the installation of an electric-operated pumping plant at its proposed waterworks, for which a fund of $1,000,000 has been arranged. H. E. Elrod, Dallas, Tex., is engineer.

Conn., Waterbury—The Waterbury Ice Corporation has broken ground for a two-story ice-manufacturing plant at Cherry and Walnut Streets, 75 x 77 ft., with L-extension, 38 x 40 ft., and will arrange a list of equipment to be installed at an early date. Tracy Brothers, Waterbury, have the general building contract.

Del., Dover—The Board of Directors, Murphy Home, has authorized plans for the erection of a power house at the institution. F. R. Watson, 1211 Walnut Street, Philadelphia, Pa., is architect. Harry Mayer, Kings Highway, Dover, is secretary of the board.

D. C., Washington—The Board of District Commissioners, District Building, will take bids until Jan. 25, for one motor-driven centrifugal pumping unit, with capacity of 3 m.g.d.

D. C., Washington—The chief of the Bureau of Yards and Docks, Navy Department, will take bids until Jan. 30, for the construction of three mooring masts at San Diego, Calif., Fort Worth, Tex., and Guantanamo, Cuba, respectively, including gasoline and water storage tanks, pumping machinery, motors, generators, winches, water and gasoline piping and auxiliary apparatus, as set forth in Specification 4916.

Fla., Ocala—A. C. Blower & Co., plan for the construction of a power house in connection with the rebuilding of their lime and phosphate works, recently partially destroyed by fire with loss approximating $35,000.

Fla., Jacksonville—The Ford Motor Co., Highland Park, Detroit, Mich., will have plans prepared in the near future for a one-story power plant, pumping station and tank house, at its proposed local assembling works on the site of the former Bentley shipyards, lately acquired, to cost in excess of $600,000, with equipment. Albert Kahn, Marquette Building, Detroit, is architect.

Fla., St. Petersburg—A. B. Hale, Tampa, Fla., and associates, are organizing a company to construct and operate a local ice-manufacturing plant, with initial output of about 50 tons per day.

Ga., Augusta—The United States Veterans' Bureau, Arlington Building, Washington, D. C., will take bids until Feb. 4, for a new hospital here, including power house equipment, Part III, as follows: boiler house equipment and piping, feed-water heater, combined twin pump and receiver, ash-handling system, smoke flue, complete water and steam distributing system in buildings; transformers, panel boards, conduits, etc., as set forth in Specification 4922. Frank T. Hines is director.

Ga., Moultrie—J. A. Kelly, Mount Pleasant, Mich., plans for the construction of a power house at his proposed local pottery, on tract of land recently acquired. A company will be formed to operate the plant.

Idaho, Boise—The Board of Trustees, Gem Irrigation District, has tentative plans for the construction of a hydro-electric generating plant at the Black Canyon dam, estimated to cost $450,000. A site at the Arrowrock dam is also under consideration. J. B. Bond is manager.

Ind., Bloomington—The Bloomington Water Co., is taking bids until Jan. 29, for two electric-operated centrifugal pumps and auxiliary equipment, with rated capacity of 1½ m.g.d., in connection with extensions and betterments at the municipal waterworks. Pearse, Greeley & Hansen, 39 West Adams Street, Chicago, Ill., are engineers.

Ind., Hammond—The Erie Railroad Co., 50 Church Street, New York, plans for the construction of a power house and pumping plant at its proposed car and locomotive repair shops on site near Hammond, estimated to cost in excess of $500,000.

Ind., Whiting—The Standard Oil Co. of Indiana, Indianapolis, is considering plans for the rebuilding of the portion of its local refinery, including boiler and power house, destroyed by fire, Jan. 1, with loss estimated at $750,000, including equipment.

Iowa, Clayworks—The Johnson Clayworks, Inc., 406 First National Bank Building, Fort Dodge, Iowa, D. G. Johnson, president, plans for the construction of a power house at its proposed local tile-manufacturing plant, estimated to cost $55,000.

Iowa, Fort Madison—The Artesian Ice Co., Hamilton and Walker Streets, is having tentative plans prepared for the erection of a one-story ice-manufacturing plant, 50 x 125 ft., estimated to cost $60,000. Bids will be called late in the spring. Herman Friedl, 508 South Dearborn Street, Chicago, Ill., is architect and engineer.

Iowa, Paullina—The Paullina Electric Power Co., is preparing preliminary plans for the rebuilding of the portion of its local power plant, recently destroyed by fire with loss estimated at $43,000, including equipment.

Iowa, Soldier—The Common Council has tentative plans under way for the installation of a municipal power plant. Bonds have been voted. Clyde E. Dickinson is city clerk.

Kan., Russell—The Common Council plans for the installation of electric-operated pumping station at its proposed waterworks, estimated to cost $95,000. J. W. Murphy is city clerk.

La., Baton Rouge—The Baton Rouge Electric Co., plans for the installation of additional boilers and other steam-power equipment at its plant, including pumping units for spray pond service. It is proposed to construct an addition to the local power station at a later date. Thomas P. Walker is manager.

Md., Hagerstown—The City Council has been denied permission by the State Public Service Commission to issue bonds for

$300,000, for the proposed municipal electric power plant, and the project will be temporarily abandoned.

Mass., Boston—The Berwick Cake Co., 2220 Washington Street, Roxbury, plans for the construction of a steam power house at its proposed four-story plant, 72 x 130 ft., on Palmer Street, estimated to cost $85,000. Bids will be taken at once by Charles T. Main, 200 Devonshire Street, architect.

Mich., Detroit—The National Ice Co., 245 Congress Street, will commence work on a one-story ice-manufacturing plant on Sterritt Avenue, to cost approximately $45,000.

Minn., Brainerd—The Northern States Power Co., Minneapolis, Minn., has plans for the construction of a hydro-electric generating plant at Oxbox Rapids, Mississippi River, near Brainerd, to cost in excess of $500,000.

Minn., Granite Falls—The City Council plans for the installation of electric-operated pumping machinery in connection with proposed extensions to the municipal waterworks, estimated to cost $35,000.

Minn., Minneapolis—The Fulton Bag & Cotton Mills, Atlanta, Ga., and 2001 East Hennepin Avenue, Minneapolis, plans for the construction of a power house at its proposed local four-story mill, estimated to cost $650,000. Frederick Kees, 246 Plymouth Building, Minneapolis, is architect.

Minn., Red Lake—The State Game and Fish Department, St. Paul, Minn., is considering plans for the construction of a cold storage plant at its proposed local fish hatchery. An appropriation has been asked.

Miss., Jackson—The Morris Ice Co., is completing plans for the erection of a one-story ice-manufacturing plant on Commerce Street, to replace its works recently destroyed by fire.

Mo., Clarksville—The La Crosse Lumber Co., has tentative plans for the rebuilding of the portion of its mill and power house recently destroyed by fire with loss estimated at $55,000, including equipment.

Mo., Kansas City—The Ford Motor Co., Highland Park, Detroit, Mich., plans for the construction of a power house at its new assembling plant on Winchester Avenue, from Eighth to Eleventh Streets, estimated to cost $650,000, for which foundations will soon be laid. The general building contract has been let. Albert Kahn, Marquette Building, Detroit, is architect.

Mo., Thayer—The Common Council is considering the construction of a municipal ice-manufacturing plant, and purposes to have plans drawn at an early date. C. H. Goething is mayor.

Mont., Great Falls—The Board of Park Commissioners is planning for the installation of a pumping plant and 60,000-gal. water tank at Giant Springs Park. Bids will be called early in the spring.

Neb., Kearney—The Common Council plans for the installation of an electric-operated pumping plant at its proposed waterworks, for which a special election has been called Feb. 5, to vote bonds for $132,800. The Burns & McDonnell Engineering Co., Interstate Building, Kansas City, Mo., is engineer.

N. C., Mebane—The White Furniture Co., has inquiries out for a generator-set, boilers, feedwater heater and auxiliary equipment for installation at its proposed power house, replacing a structure destroyed by fire, including plant, with loss aggregating $300,000. Noted Jan. 8.

N. J., Atlantic City—The American Ice Co., City Centre Building, Philadelphia, Pa., has rejected bids recently received for the proposed one-story addition to its ice-manufacturing plant, 45 x 140 ft., at Michigan and Arctic Avenues, and purposes to call for new quotations in the near future. C. Leslie Weir, 45 East Forty-second Street, New York, is engineer.

N. J., Lambertville—The City Council has authorized plans for a sewerage disposal plant, with pumping machinery and other power equipment, to cost $130,000, for which bids will be called in the near future.

N. J., Newark—Adolph Segal, Pennsylvania Building, Philadelphia, Pa., head of the Wilmington Sugar Refining Co., Wilmington, Del., is negotiating for a site at Port Newark, to be used for a proposed sugar refining plant, with power house, pumping plant and other mechanical departments, estimated to cost $1,000,000.

N. J., Newark—The Board of Education, County Vocational Schools, 31 Clinton Street, plans for the construction of a power house at the proposed vocational school for boys to be erected at Myrtle Avenue and University Place, Irvington, for which an appropriation of $250,000 has been approved. Motors, controls and other power equipment will also be installed in the structure. Bids will be asked in the near future.

N. Y., Buffalo—The Board of Water Commissioners has rejected bids lately received for centrifugal pumping equipment for use at the proposed filtration plant at the city waterworks, estimated to cost $4,000,000, and will ask for new quotations in the near future.

N. Y., Buffalo—The Ford Motor Co., Highland Park, Detroit, Mich., will build a power house at its proposed local assembling plant, for which a site has just been selected on the River Road, near Hertel Avenue, estimated to cost in excess of $500,000. Albert Kahn, Marquette Building, Detroit, is architect.

N. Y., Elba—The Elba Cold Storage Co., 635 East Ferry Street, Buffalo, N. Y., F. Stevenson, president, is taking erection bids for its proposed local cold storage plant, to be two-story, 100 x 140 ft., estimated to cost $125,000, with equipment. The Industrial Planning Co., 80 West Genesee Street, Buffalo, is mechanical engineer.

N. Y., New York—The Anheuser-Busch Ice & Cold Storage Co., 979 Brook Avenue, will take bids at once for extensions in its plant, including remodeling of present structure and installation of additional equipment, estimated to cost $165,000. Orphuls & Hill, 112 West Forty-second Street, are engineers.

N. Y., New York—The Lago Petroleum Co., recently organized as an interest of Cosden & Co., 730 Fifth Avenue, oil refiners, and headed by J. S. Cosden and H. N. Greis, has tentative plans under advisement for an oil storage and distributing plant in the Maraciabo section, Venezuela, where a tract of over 2,000,000 acres of oil lands has been secured, to include power house, pumping plant and other mechanical units.

N. Y., Raybrook — The State Hospital Commission, Capitol Building, Albany, is considering the erection of a two-story cold storage plant at the local state hospital, estimated to cost $100,000, with equipment. L. M. Farrington is secretary. Sullivan W. Jones, Capitol Building, state architect.

N. Y., Rome—The Board of County Supervisors has plans under consideration for the construction of an ice and refrigerating plant at the local county home. Charles A. G. Scotham, Court House, Utica, N. Y., is purchasing agent.

N. Y., Syracuse—The Star Dry Cleaning Co., 1205 West Genesee Street, will commence the erection of an addition to its steam power house, in connection with an extension to its mechanical laundry, estimated to cost about $37,000.

N. C., Balfour—The Balfour Cotton Mills, Inc., will build a power plant at its proposed local textile mill, for which ground will be broken before the close of the month. It will cost about $225,000. Ellison A. Smythe is president, with headquarters at Greenville, S. C.

N. C., Greenville—The Common Council, J. O. Duval, clerk, will receive bids until Jan. 24, for one 1250 kw. steam turbo-generator, switchboard and auxiliary equipment for the municipal power station. Edward E. Williams, Greenville, is engineer.

N. D., Grand Forks—The Common Council has preliminary plans under consideration for the installation of a municipal power station, using a Diesel oil engine, for the street-lighting system and water pumping plant. Charles E. Evanson is city clerk.

Ohio, Toledo—The H. J. Heinz Co., 1062 Main Street, Northside, Pittsburgh, Pa., is reported to be planning for the erection of a new canning plant and power house, on local tract of land on Oak Street, totaling 150 acres, recently acquired. It is expected to cost in excess of $500,000, with machinery.

Ohio, Toledo—The People's Ice & Storage Co., recently organized, has acquired property on Champlain Street, 100 x 138 ft., for the erection of an ice-manufacturing plant, occupying the entire site, estimated to cost $150,000, with equipment. It will have an initial capacity to about 110 tons per day. Plans will soon be drawn. A. W. Kalb, Danberry, Ohio, is interested in the new concern.

Okla., Enid—The City Council has plans under consideration for the installation of a waterworks, with electric-operated pumping plant. F. C. Magruder is engineer.

Ore., Bend—The Bend Water, Light & Power Co., has tentative plans under advisement for the construction of a hydro-electric power plant on the Tumalo River, with initial capacity of about 5,000 hp. T. H. Foley is general manager.

Ore., Hood River—The Oregon Lumber Co., has tentative plans under consideration for the construction of a power dam on the Hood River, for proposed hydro-electric power development for service at its mills.

Ore., The Dalles—The North Dalles Irrigation District plans for the construction of a series of pumping stations in connection with its proposed irrigation system, totaling 5,000 acres, estimated to cost $425,000. William J. Roberts, Tacoma, Wash., is engineer.

Pa., Philadelphia—William D. Whitaker, Emerald and Westmoreland Streets, manufacturer of rope, twines, etc., will build a power house at its proposed three-story plant at N Street and Sedgley Avenue, estimated to cost $110,000, for which a general erection contract has been awarded to the William Steele & Sons Co., 219 North Broad Street.

Pa., Reading — The Reading Hardware Co., has authorized plans for the construction of a power house at its local plant, 83 x 88 ft., to cost in excess of $50,000, with equipment. The Ballinger Co., Twelfth and Chestnut Streets, Philadelphia, is architect and engineer.

Tex., Elgin—The Elgin Power & Light Co., will break ground at once for the construction of its proposed one-story ice-manufacturing plant, for which plans have been prepared by Giesecke & Harris, Littlefield Building, Austin, Tex., architects.

Tex., Dalhart—The Dalhart Water Co., plans for extensions and improvements in its waterworks, including the installation of pumping machinery and other equipment.

Tex., Omaha—H. M. Ferrier, Omaha, and associates, plan for the construction of a power house at their proposed local textile mill, for which plans will be prepared at an early date, estimated to cost in excess of $350,000.

Va., Bedford—The Bedford Tire & Rubber Co., recently organized with a capital of $1,000,000, plans for the construction of a power house at its proposed local mill, estimated to cost $125,000. J. J. Scott is secretary and treasurer.

Va., Big Stone Gap—The Common Council plans for the installation of a pumping plant in connection with the proposed municipal waterworks, for which a bond issue of $38,000, is being arranged.

Va., Danville—The Board of Works will commence extensions and improvements in the waterworks, to include the enlargement of the present pumping plant and the installation of electric-operated pumping units and auxiliary equipment.

Wash., Bellingham — The Utah-Idaho Sugar Co., Salt Lake City, Utah, will build a power house at its proposed refining plant on tract of land to be acquired in this section, estimated to cost close to $1,000,000, with machinery.

Wash., New Dungenes—The Bureau of Yards and Docks, Navy Department, Washington, D. C., has plans in preparation and will soon take bids for rebuilding the power plant at the local radio compass station, to be carried out under Specification 4938.

Wash., Okanogan—The Epso Products Co., Oroville, Wash., plans for the construction of a power house at its proposed local plant, estimated to cost in excess of $85,000.

Wash., Omak—The Biles-Coleman Lumber Co., plans for the construction of a power house at its proposed mill in the Colville Reservation, to cost in excess of $150,000, with machinery.

Wash., Tacoma—The City Council is taking bids until Jan. 21, for the sale of bonds for $4,000,000, the proceeds to be used for the construction of the first unit of the proposed hydro-electric power plant at Lake Cushman.

Wash., Tacoma—The Veneer Products Co., Lewis and Watts Streets, will build a one-story steam power house at its works, Fifteenth and Dock Streets, to cost about $26,000.

Wash., Wenatchee—The Morris, Lockenbeck & Pate Co., is having plans prepared for the construction of a cold storage plant and food products warehouse, estimated to cost $400,000, with equipment. Morrison & Stimson, Spokane, Wash., are engineers.

Wis., Coon Valley—E. J. Beranek, 520 Cass Street, La Crosse, Wis., is planning for the rebuilding of his electric light and power plant, used for local commercial service, recently partially destroyed by fire with loss of about $23,000.